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Fig. 1—Bar work for printing presses. Fig. 2—Where gears and pulleys are turned

Machine-Tool Arrangement for Processing Parts

By H. H. Edge

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A successful operating plan that provides for dividing the parts to be machined into two classes—round work and flat work

THERE are two well-established plans for the arrangement of machine tools, departmentally, in factories engaged in processing metal parts. We considered both of these plans, but they do not meet our conditions, and have not been followed in arranging the machinery in the plant of the Kelly Press Division of the American Type Founders Co., Elizabeth, N. J. In order to better understand the different plans, the usual practice in locating and installing the various types of machine tools by departments in metal working factories, will be referred to first.

When the parts to be machined are comparatively small, as required for the assembly of sewing machines, typewriters, telephones, etc., it has been found best in many cases, to group the machines according to their class. This plan provides for grouping the lathes in one department, the milling machines in another, the drilling machines in another, the grinding machines in another, and so on for the various kinds of machines required for production. This arrangement makes it necessary to move the work from department to department for the different classes of machine operations required to complete it. Such parts are usually produced in large quantities and are not bulky, and the disadvantage of moving the work is more than offset by the advantages of having the machine tools of a class, grouped together and operated by specialists.

When the parts to be machined are larger than the class above referred to, the usual plan of machine-tool arrangement is controlled by the operations required to completely machine the part in the department where the first operation is performed. This plan provides for the machines being arranged, so that production operations can be finished in their proper sequence on the various types of machines required for the work. Grouping machine tools in accordance with the succession of operations, has proven very efficient for machining gasoline-engine parts, such as cylinders, pistons,

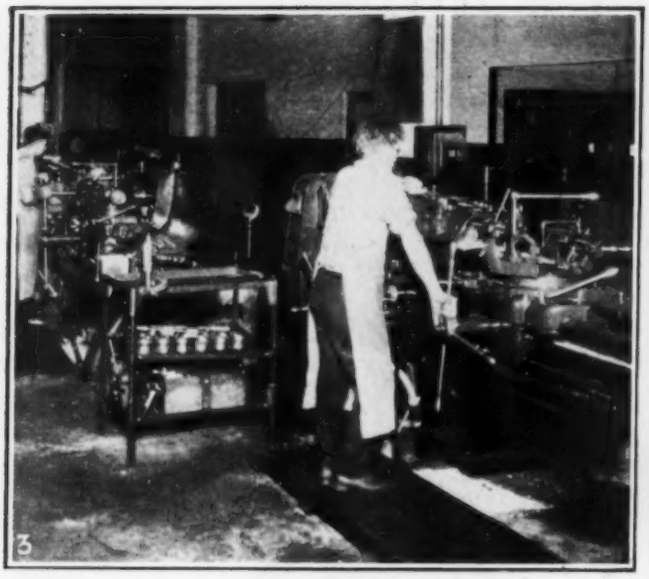


Fig. 3—Hand-turret bar work.

Fig. 4—Cylindrical grinding

crankcases, etc., and is usually followed in the machine-tool arrangement in plants engaged in the manufacture of automobiles and similar work. This plan eliminates the necessity for trucking between operations, and is particularly well adapted to manufacturing conditions requiring large production and the completion of predetermined quantities of parts, each day.

There are several sizes of Kelly automatic printing presses manufactured, the net weights being from 3,900 to 10,500 lb. each. After considering the above plans for machine arrangement, and realizing the importance of saving unnecessary handling and trucking of the work between operations, it was decided to classify and segregate the work in process by the kind of surface to be machined.

The parts that make up the various types of presses have been divided into two classes, round work and flat work. If the major machine operation for the part can best be finished on a lathe or some other type of turning machine, the part is classified as round work. If the major machine operation is flat and it can best be finished on a planer, milling machine or some other flat surfacing machine, it is classified as flat work.

The floor space and machinery required for finishing the two classes of work are nearly equal. The machines required for the major operations of the round work, are engine lathes, vertical and horizontal turret lathes, boring machines, automatic chucking and rod machines, cylindrical grinding machines, etc. The gear cutting and cam cutting machinery and a few drilling and slotting machines are installed with this group, so that all machine operations required to complete this class of parts from the rough to their finished state are available on the floor or in the department where the round work is machined. When the parts are moved from the department they are ready for inspection, and if accepted, are moved to the finished storerooms located on the sub-assembly and erecting floors—the parts used in the sub-assemblies being consigned to the sub-assembly store, the other parts are stored in the finished-parts stores on the erecting floor.

The machines required for the major operations of the flat work, are planers, milling, boring and grinding machines. These machines have been grouped and installed so that the operations on this class of work can be completed without unnecessary trucking. The

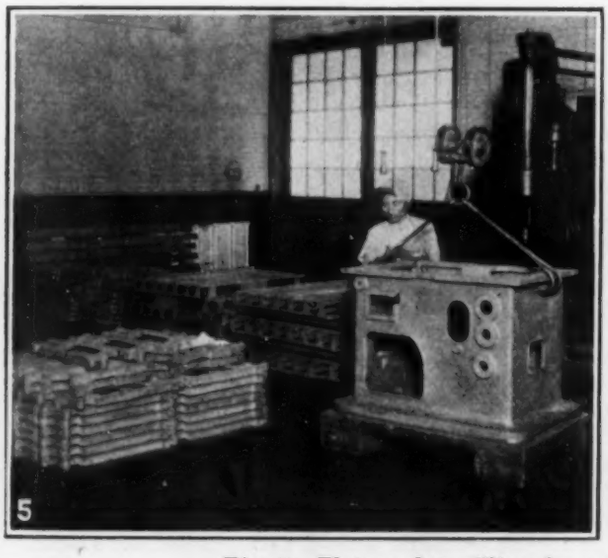


Fig. 5—Flat work—milling frames.

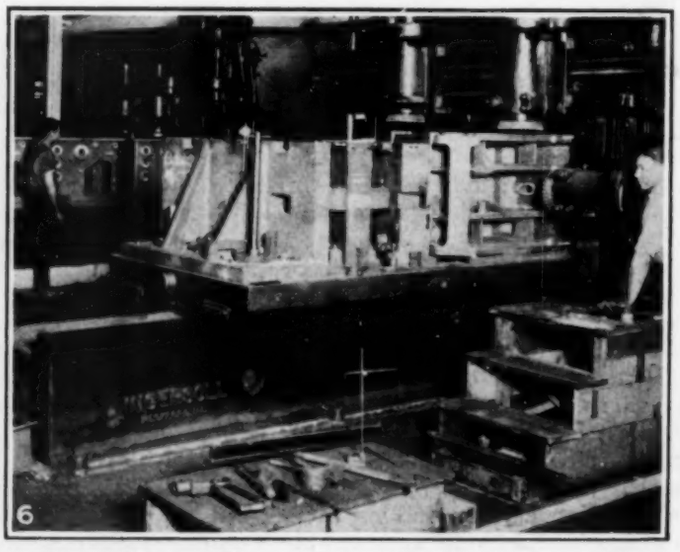


Fig. 6—More milling of flat surfaces

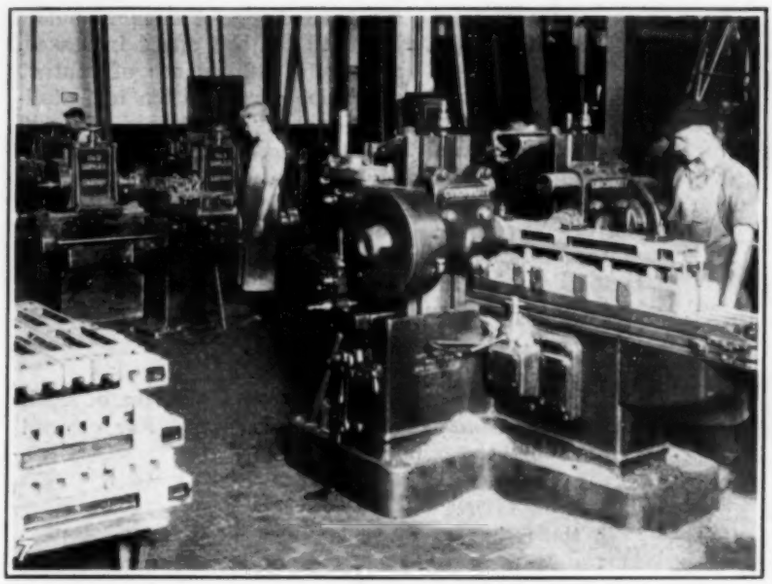


Fig. 7—Smaller surface milling. Fig. 8—Planing small parts

minor machine operations on the flat work are also completed on the floor or in the department where the machine work is started. When the job is finished, the work is inspected and if accepted, is transferred to the finished stockrooms located on the sub-assembly and erecting floors.

Two Grinding Departments Planned

This plan of machine-tool arrangement provides for two grinding departments, the flat or surface grinding machines being located on the floor with the planers and milling machines—the cylindrical type of grinding machines are located on the floor with the lathes and other turning machines. There are two drilling departments, one each for the flat work and the round work. The larger drilling department is located on the floor where the flat work is machined, since this class of work requires more drilling and tapping than the parts classified as round work.

All rough, or unmachined castings for round work are stored on the floor where this work is machined. The rough castings for flat work are stored on the same floor level with the planers and milling machines. This division of the work into two classes, makes it easy to locate the rough castings in stores, also to locate the parts when in process of machining. Foremen, storekeepers and others can usually locate any part in production without referring to records, since its shape indicates the floor, rough store, and the location of the machines for all operations that are required to complete it.

As separate departments have been provided for both the round work and the flat work, it has not been found difficult to keep the work in its proper place. The plan has proved to be so practical and easily understood, that there has been very little confusion in getting it in operation. Every manufacturing job has its problem, and the best results cannot be obtained by following fixed rules or theories, but the classifying of our machine work into two general divisions, and the arrangement of the machinery as here described, has reduced the trucking of our parts in process over 50 per cent and has been very helpful in increasing production and reducing manufacturing costs.

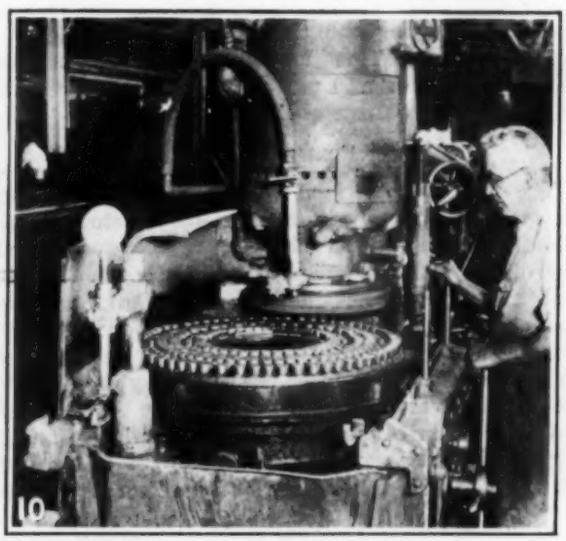


Fig. 9—Grinding plane surfaces. Fig. 10—Surfacing the ends of links

The Elimination of Waste in Belting and Transmission Equipment

By W. E. Nicholls

ELIMINATION of waste and increased production are two points to which every manufacturer, plant manager and superintendent must give closer attention than ever before. It is necessary to stop the leaks, many of which have gone on for years, and which may have been too small to attract attention.

One concern with which I am acquainted, maintains a research department of twelve men who do nothing but investigate details too small for departmental managers' attention. As a result, in the past three years they have reduced the cost of belting from $1.00 to $0.53 per unit produced, and there will be a further reduction this year. Similar consideration has been given to the economies in the use of grinding wheels, drills, reamers, cutting compounds, etc., and the results amount to hundreds of thousands of dollars.

Consider the Belting

The condition under which belting is required to perform is rarely given the consideration it deserves. Generally, new machinery is in the plant before any thought is given to the question of how it is to be driven, and then the matter is left to the judgment of the millwright. The result, in many cases, is that it is impossible for the machines to develop their rated or maximum production.

Where jackshafts are employed, little consideration is given to the variation in speed between the belt from the motor or line-shaft and that from the jackshaft to the machine. A recent example showed the belt speed from the motor to the jackshaft to be 2,200 ft. per min., and from the jackshaft to the machine, 647 ft. per min., both belts being of the same width and weight.

The principle loss, due to heavy friction, is mainly caused by the use of belting of too light weight requiring the belt to be kept at an excessive tension to drive the load. Excessive tension causes undue wear on bearings and clutches or loose pulleys, with heavy maintenance cost, to say nothing of the loss in production during the time the machine is idle for their repairs. This trouble can be considerably reduced, sometimes 50 per cent, by using heavier belting which can be run at a lower tension.

Shift Forks Wear Belting

The lack of attention given to belt-shifted forks on machines, causes a considerable waste of money. I had under my supervision for over six years, a number of English planers that did not cost one-half for belt maintenance as did the American machines in the same department. This difference was entirely due to the English machines being equipped with roller shifter forks. Some of the ordinary shifter forks wear belts very badly.

Often, when belts will not pull their loads, and it is impossible on account of space to get wider pulleys on the line, the trouble may be eliminated by putting on larger pulleys. By this change the same pulley ratios can be maintained and the belt speed increased.

The question of the amount of the arc of contact of the belt is rarely given due consideration in installing pulleys. A 6-in. belt running at a speed of 1,000 ft. per min., and with 180-deg. arc of contact will develop 20 hp., but only 18.5 hp. with 160-deg. arc of contact. The majority of horsepower tables for belting are based on 180 deg. arc of contact, but in most of the cases encountered in practice, the arc of contact is 160 deg., or less.

A simple formula for computing the arc of contact is:

$$\text{Arc} = 180 - 60\frac{D-d}{e}$$

in which D = diam. of large pulley; d = diam. of small pulley; e = distance center to center. For crossed belts change the minus sign to plus.

Use of the Flywheel

In the reduction of the number of cast-iron pulleys in use, the question of flywheel action upon shafts transmitting intermittent power, such as board drop-hammers, has been lost sight of. Experiments made upon a 4,000 lb. board drop-hammer, showed that the belt from the motor to the jackshaft thrashed badly each time the hammer was raised. This condition was entirely eliminated after the installation of a 500-lb. flywheel upon the jackshaft. In the new hammer shop of this company, 3 1/8- and 4 7/8-in. shafting is used, according to the size of the hammers operated, and each group of hammers is driven by a 100-hp. motor belted to a 54-in. flywheel of 5,000 lb. weight, that acts as a driven pulley.

In too many cases, even large plants put the belting in charge of cheap help. In some instances, good results are secured by putting these men on a bonus system of payment, based upon their reducing the amount of idle time of machines for belt repairs. Before putting any man upon belt repairs, he should receive instructions as to the functions of his work. Why go to the expense of purchasing the most modern machinery to decrease cost and increase production, and then put it in the hands of unintelligent labor to maintain its drive, upon which its production depends?

A Few Simple Rules

The following outline may prove of assistance in removing some of the belt troubles encountered:

Make an inspection of each individual machine, carefully noting under what conditions the belt operates.

See if the pulley can be increased in diameter, to give a greater arc of contact. Reduce centrifugal action by the use of belting having a uniform thickness; this reduction can sometimes be by substituting fabric for leather.

Do away with loose pulleys of less diameter than the tight pulleys. Such pulleys cause more wear and destroy more belts by their having to mount the flange or angle upon them when shifting from the loose to the tight pulley, causing the leather to "dub" up or the fabric to become frayed.

Use roller shifter forks of good construction, and not made merely of a piece of pipe.

Take pains to see that your belt-repair man is properly instructed regarding the tension at which to apply belts, as well as the correct methods of lacing them, and to immediately report to his superior any unusual belt troubles.

Extract of a paper, presented at the Convention of the American Pulp and Paper Mills Superintendents' Association, Elkhart, Ind., Sept. 4, 1925.

The Effect of External Load on Fastenings

A discussion in regard to the effect of an external load on a fastener that has an initial load in the same direction

By Horace W. Leet
Assistant Professor of Machine Design, University of Rochester

THERE have been, from time to time, discussions in regard to the effect of an external load on a member that already has an initial load in the same direction due to its use as a fastener. This question arises: De we take the sum of the two loads, the greatest, or something in between? The conditions of each problem will govern the proportion of external load to be added to the initial.

An attempt has been made in this discussion, to obtain a general rule that will solve such problems.

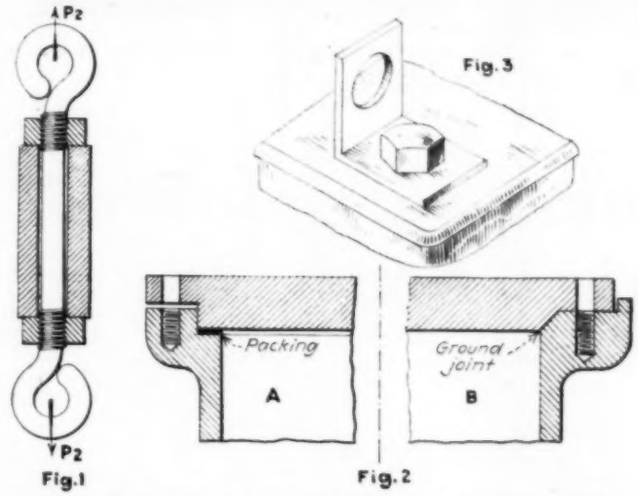


Fig. 1—Bolt passing axially through a hollow cylinder. Fig. 2—Cylinder head of an engine. Fig. 3—Cap screw used for double fastening

To get to a general expression, the particular case of a bolt passing axially through a hollow cylinder, is taken, as in Fig. 1. The following notation is used:

E = modulus of elasticity of bolt material
E' = modulus of elasticity of cylinder material
S_1 = stress in bolt due to screwing up
S = final stress in bolt
P_1 = initial load on bolt, screwing up
P_2 = applied external load on bolt
P = final load on bolt
P' = final load on cylinder
S_1' = stress in cylinder due to screwing up
S' = stress in cylinder after P_2 is applied to bolt
e = unit elongation of bolt
e' = unit elongation of cylinder

Under the action of P_2, the bolt elongates positively and the cylinder elongates negatively. With the second load, P_2, applied to lengthen the bolt, two things must be accomplished simultaneously. First, the bolt and cylinder must lengthen equally. Next, the load must divide itself between lengthening the bolt and relieving the cylinder. Notice that this treatment of the problem is on the basis that the fastener always exerts a load on the fastened member.

Elongation of the cylinder with P_2 = elongation of the bolt.

The ratio of loads required for equal elongations, bolt to cylinder $= \frac{aE}{AE'}$ for $e = \frac{P_b}{aE}$ and $e' = \frac{P_c}{AE'}$.

P_b = part of P_2 to relieve cylinder

If $e = e'$,

$$\frac{P_b}{P_c} = \frac{aE}{AE'}$$

Where P_b = part of P_2 on bolt,
P_c = part of P_2 to relieve cylinder.

Since P_2 not only elongates the bolt by applying P_b it must necessarily relieve the cylinder of load P_c.

$$\therefore P_2 = P_b + P_c$$

$$P_b = P_2 - P_c = P_2 - \left(\frac{AE'}{aE}\right) P_b$$

$$P_b = P_2 \left(\frac{aE}{AE + AE'}\right) = P_2 \left(\frac{\frac{aE}{AE}}{1 + \frac{aE}{AE'}}\right).$$

Calling $\frac{aE}{AE'}$ the yield factor of member to fastener $= y$ and x that part of P_2 to be added to P_1,

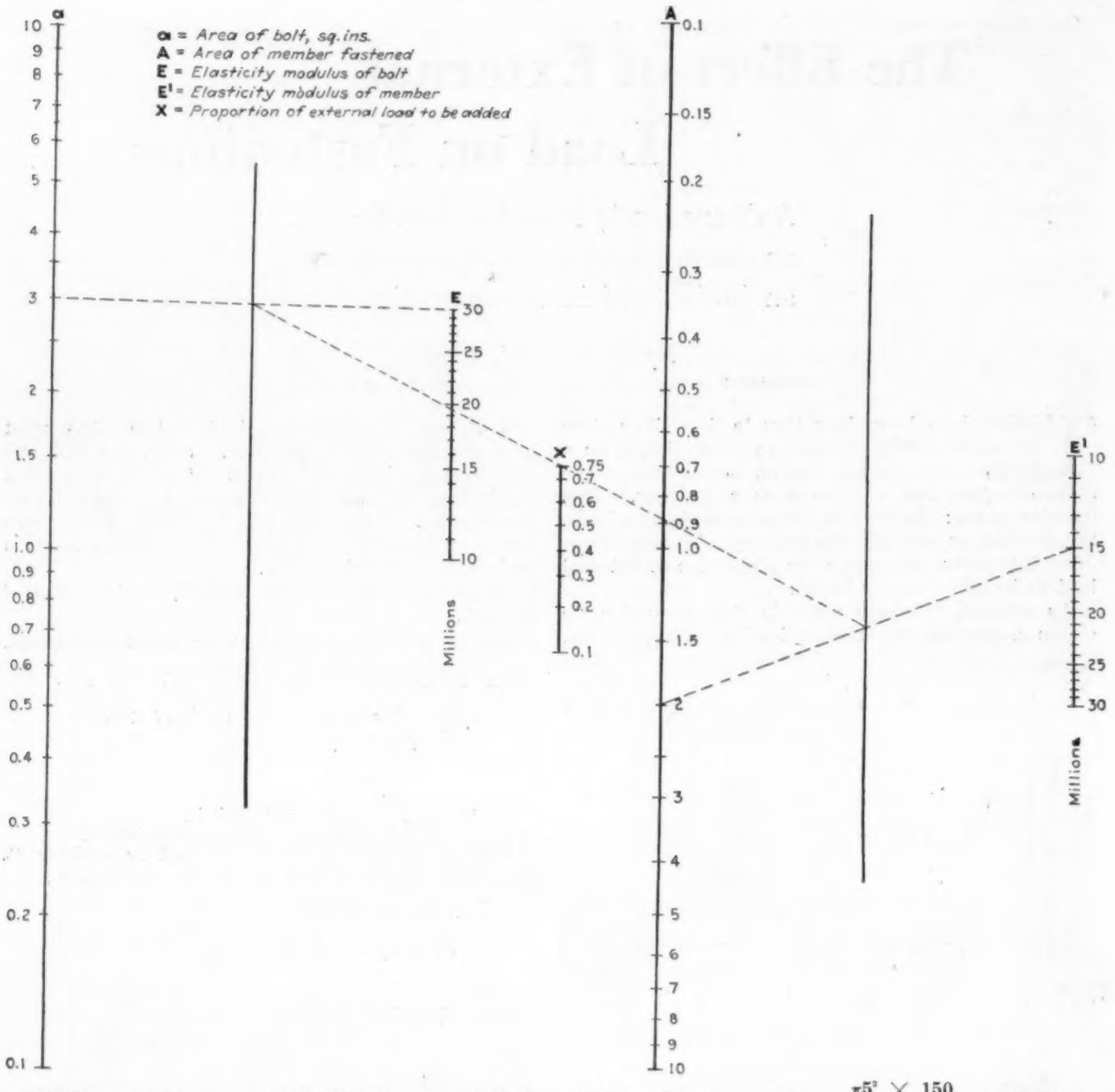
We have $P = P_1 + xP_2 = P_1 + \left(\frac{y}{1+y}\right) P_2$ and

$$S = \frac{P}{a} = S_1 + \left(\frac{y}{1+y}\right)\frac{P_2}{a} = S_1 + \frac{xP_2}{a}$$

Similarly, P' on the cylinder $= P_1 - (1 - x)P_2$ and

$$S' = \frac{P'}{A} = S_1' - (1 - x)\frac{P_2}{A}$$

This factor y in the practical case may not always be determined exactly but may usually be estimated quite closely. Where the areas involved are known, and we have no intermediate members to change the action, we may use the accompanying chart and obtain the multiplying factor for P_2 directly. The example is given where the bolt has an area of 3 and a modulus of 30,000,000. The fastened member has an area of 2 and a modulus of 15,000,000. The X scale is not carried above 0.75, since when the fastened member has a higher yield compared to that of the bolt than in this



particular case, the sum of initial and external loads should be taken.

Now we may look at some of the practical aspects of the problem, where it will be necessary to estimate the ratio of yield of the fastened member to that of the fastener.

The cylinder head of an engine offers a chance for a wide range of yield factors. If it is fitted as in *A*, in Fig. 2, it is much more yielding than the stud, and probably a factor of from 4 to 5 should be taken, depending upon the diameter of stud. If we use 4, about $\frac{1}{5}$ the external load should be added to the initial load. For *B*, a yield factor of about $\frac{1}{3}$ or $\frac{1}{4}$ will be expected, giving 0.2 to 0.25 times the external load to add to the initial load.

A particular case will be taken to illustrate case *A* further. The following data are used:

Steam pressure = 150 lb. gage.
Diameter of cylinder = 10 in.
Number of bolts = 12.
Bolt diameter = $\frac{5}{8}$ in.

$$\text{External load per bolt} = \frac{\pi 5^2 \times 150}{12} = 980 \text{ lb.}$$

Initial load per bolt (for tight joint) = $3 \times 980 = 2{,}940$ lb.

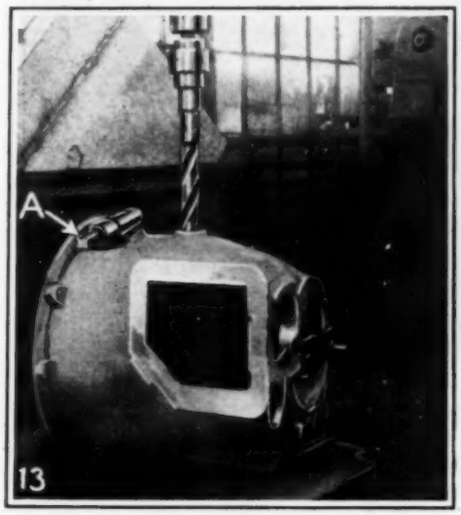
$P = 2{,}940 + (0.8 \times 980) = 3{,}725$ lb.

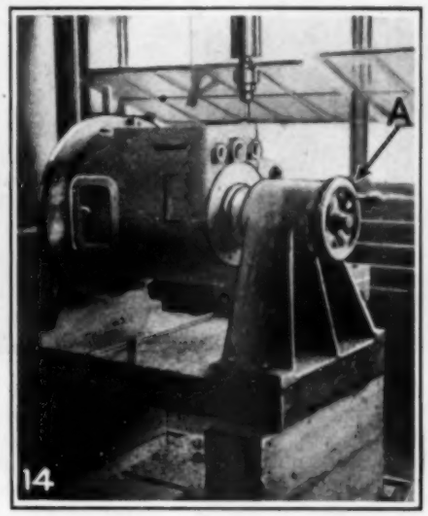
$$\text{Tensile stress in bolt} = \frac{3{,}725}{0.202} = 18{,}400 \text{ lb. per sq.in.}$$

It may be concluded that the initial load plays the most important part in loading such a fastener. This is particularly true on all sizes up to $\frac{3}{4}$ in., since lack of judgment in applying a wrench may mean an initial load of 40,000 to 50,000 lb. per sq.in., and a very good chance for failure when the external load is applied.

Another case is shown in Fig. 3. The cap screw is used to fasten the plate to the frame and in addition is holding a clip to which a cable may be attached. The external load applied to the clip would produce a bending stress in addition to direct stress. Since the bending effect does not tend to relieve the screw of the load between it and the plate, as in our theoretical case, its effect should be added in with no multiplying factor.

Automotive Production





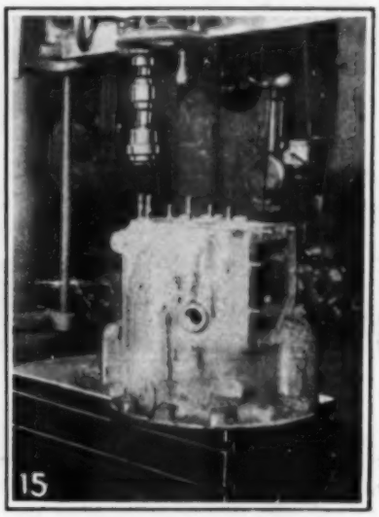


Fig. 13—Drilling and tapping 1¾-in. pipe-plug hole. Fig. 14—Work set up for drilling side-pad holes. Fig. 15—Tapping and driving studs in case

Machining the Transmission Case of the Mack Truck and Bus

By Frank W. Curtis
Associate Editor, *American Machinist*

Method of driving studs — Forming selector-shaft holes—Rigid inspection methods employed —Machining operations for the top cover

THE ninth operation performed on the transmission case of the International Motor Co. is the drilling and tapping of the 1¾-in. pipe-plug hole on a Fosdick radial drill, as shown in Fig. 13. The work is held against one side of the compound table by a C-clamp tightened against the front side. A 1$\frac{13}{32}$-in. hole is drilled through the work after which the tap, shown at *A*, is used, driven by the quick-change chuck.

Tapping all the pad holes in the sides, driving in the studs, drilling three $\frac{21}{64}$-in. holes and tapping them to $\frac{7}{16}$-in., 14 threads is operation 10, illustrated in Fig. 14. A Niles-Bement-Pond radial drill is used. All the studs are inspected carefully with a Hartness comparator for accuracy before they are used. For driving they are dipped in white lead and started by hand, after which the stud driver is brought down to drive them into place. They are driven at a speed of 36 ft. per min. The fixture is of the trunnion type, the work being clamped in position by the handwheel *A*. The operation is as follows: Insert tap in quick-change chuck and tap seven $\frac{7}{16}$-in. holes, insert stud driver and drive seven studs to shoulder, index fixture and drill three holes, then tap to $\frac{7}{16}$ in. and drive studs in place. Male gages are used for checking the threads before the studs are driven.

The eleventh operation is similar to the preceding one in that it taps four $\frac{5}{8}$-in.-11, six 0.493-in.-13 and six 0.368-in.-16 holes. The fork is fastened to the table of a Morris radial drill, shown in Fig. 15, in which the Errington stud driver is shown in position. Operation 12, illustrated in Fig. 16, is the drilling of the $\frac{3}{4}$-in. oil hole on a small radial. The work is located in the fixture at an angle by a stud in the 5$\frac{3}{4}$-in. hole,

The conclusion of the article. The first part appeared on page 729, Vol. 63.

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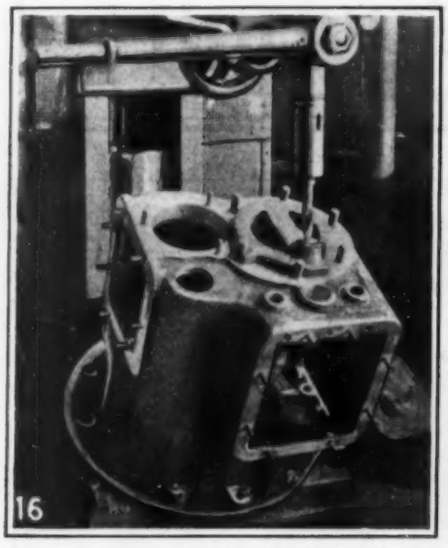
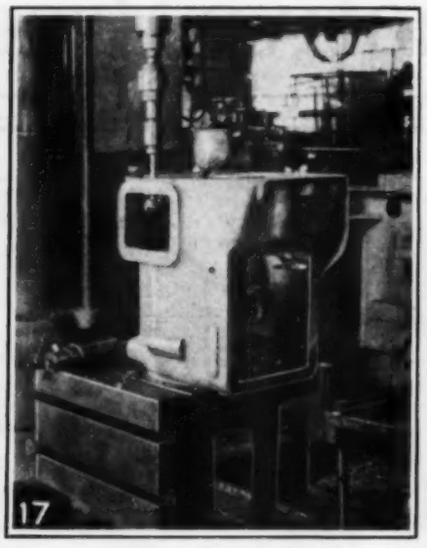




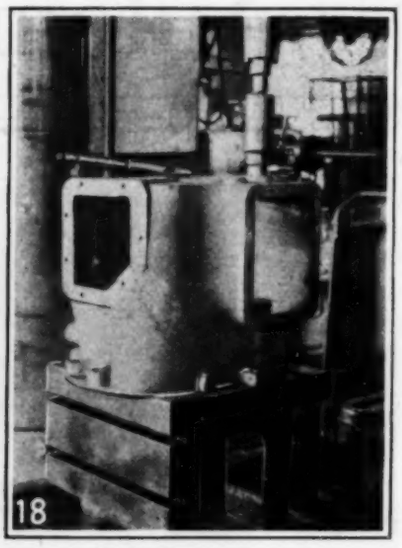


Fig. 16—Drill jig for ¾-in. oil hole. Fig. 17—Spotfacing inside and outside bosses. Fig. 18—Forming selector-shaft holes

clamping being provided by a C-washer and nut. The plate jig *A*, located in the 5.936-in. hole and by the stud *B*, carries the drill bushing so that the drill starts easily on the angular surface of the case. The drill is run at 530 r.p.m. and fed through the work by hand. The illustration shows the studs that were driven in the two preceding operations.

Operation 13 is the spotfacing of one inside and seven outside bosses to 1⅛ in. and spotfacing the 1¾-in. diameter bore, on an American radial drill, shown in Fig. 17. The work is clamped to the table of the machine, the pilot bar is inserted through the hole and the spotfacing tool is fastened by a bayonet-locking device. The spindle is raised until the boss has been spotfaced to the proper thickness, which is checked by calipers. The spotfacer in position may be seen in the illustration, while at *A* is shown the spotfacer for the larger hole. This cutter is made in the form of a fly-cutter, and is used on the opposite side of the work after it has been reversed and clamped. The speed of the spotfacers is 90 ft. per min. and they are hand operated to stops set on the quill of the machine.

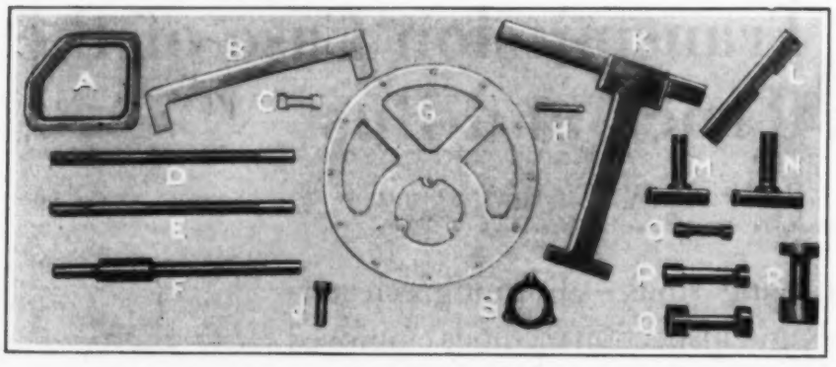
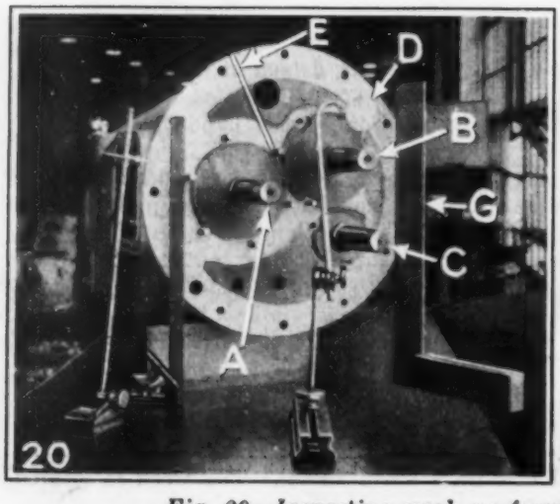


Fig. 19—Gages used for inspecting transmission case

The last machining operation is the forming of two selector-shaft holes, operation 14, illustrated in Fig. 18



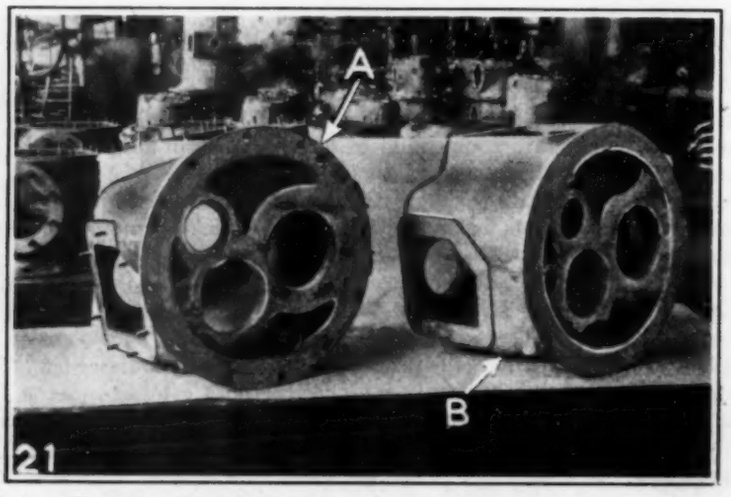
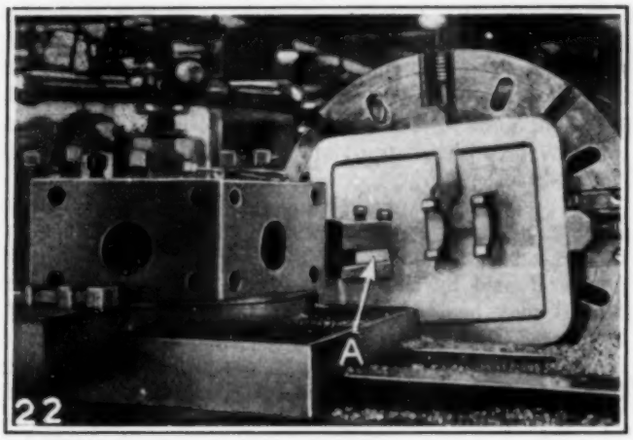


Fig. 20—Inspecting work on faceplate. Fig. 21—Finished case and a rough casting

AUTOMOTIVE PRODUCTION



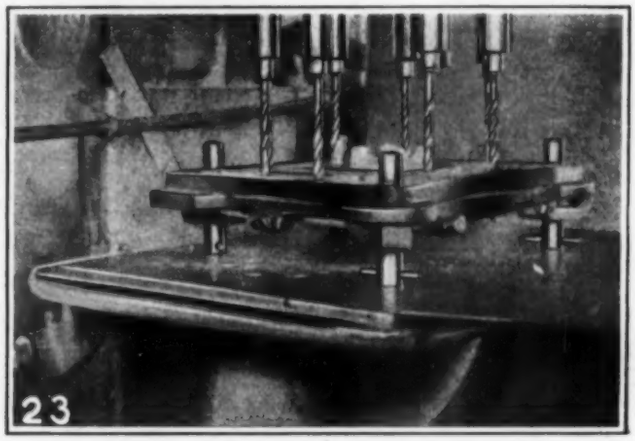


Fig. 22—Facing the transmission-case top cover. Fig. 23—Drilling eight holes in cover

and handled on an American radial drill. The work, located on the table of the machine and clamped from the inside by a C-clamp, is faced first by the cutter bar, then by the forming fly-cutter shown on the top of the work. Operation 15 is the hand line-reaming of the three selector-shaft holes, in which the work is set in gangs on a bench, the operator working from one to the other. The cases are then washed in a Niagara washing machine and dried by compressed air. Operation 16 is bench work and calls for the removal of all burrs from the holes and machined surfaces, retapping of the ⅜-in.-11 holes and countersinking eight ⅜-in. holes to remove burrs. Five cases are placed on a bench at a time, the operator working them in sequence. At this stage the transmission case is completely machined and ready for inspection.

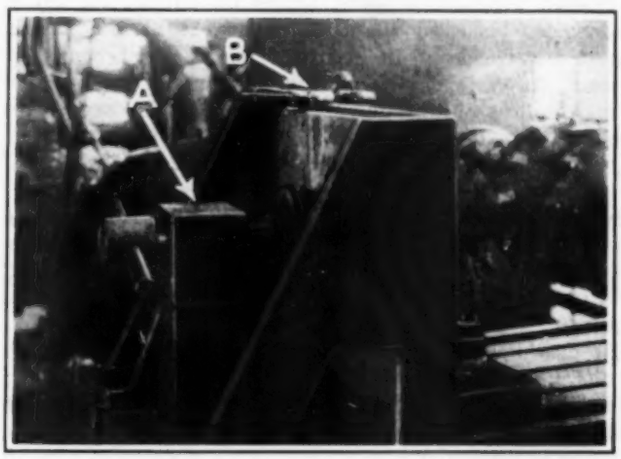


Fig. 26—Straddle milling two lugs on cover

Inspection Methods

The inspection of the case is handled in the department in which the machining is accomplished. The work is arranged on three short benches, 14 in. in height, each bench holding eight pieces, or a total of 24. Two inspectors, using the various gages required, pass from one piece to the next so that each gage is used on every piece and all the surfaces, holes and locations are completely checked. Fig. 19 shows the gages used for this work. At *A* is shown the cover used for checking the location of the studs. A stock cover is used. It must fit over the studs

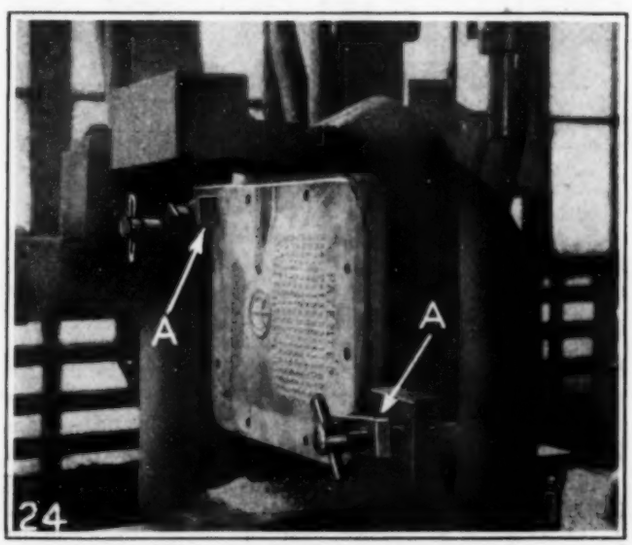


Fig. 24—Index-jig for two ⅛-in. oil holes. Fig. 25—Index-jig reversed for opposite hole

AUTOMOTIVE PRODUCTION

freely. The snap gage at *B* is used for the overall length 16.748-16.752 in., being a duplicate of the gage used in the third operation. At *C* is illustrated the depth gage for the recess of the retainer, limits 0.122-0.128 in. The alignment bars *D* and *E* are used for checking the parallelism of the selector-shaft holes, while *F* is a similar gage used for the hole that is 1¾ in. in diameter at one end. The plug gage *J* is used for the pipe-plug hole and *G* is the plate gage for checking the location of the studs in the flange. A thread gage *H* is used for the four flange holes, having a limit of 0.003 in. The gage *K* is used for checking the bore with the face. It is inserted in the hole so that the plate rests on the flange, then feelers are used for checking the alignment. The plug portion of the gage is 0.001 in. under the low limit of the hole and a tolerance of 0.003 in. is allowed. The gage for the reverse-idler shaft, at *L*, checks the distance between the counterbores, limits of ±0.004 in. being allowed. The plug gages *M*, *N*, *O*, *P*, *Q* and *R* are used for checking the various bores throughout the case. At *S* is shown an actual component used for checking the reverse-idler studs. The holes are ⅛ in. larger than the studs over which they fit.

If, for any reason, the accuracy of a case is in doubt, the case is mounted on a faceplate, as shown in Fig. 20, for inspection. Three plug gages *A*, *B* and *C* are assembled through the bores at both ends of the case. To the ends of each plug, ground accurately to diameter, an indicator *D* is applied, as illustrated. The tolerance permitted between the ends of any plug is 0.002 in., the case being scrapped if the measurement is beyond this limit. The bores must be parallel to 0.002 in.; parallelism being checked by feelers applied between the collars of the plugs, shown at *E*. The face of the flange is inspected for squareness by the square *G* with the use of feelers, the tolerance being 0.002 in. All the limits are so rigidly maintained throughout the machining operations that it is seldom necessary to scrap a case at the final inspection due to incorrect sizes. In Fig. 21 is shown a completed case at *A* and a rough casting at *B* to furnish a comparison in the two conditions.

Machining the Cover

The transmission-case top cover, machined in the same department, is made of an aluminum casting, having an analysis similar to that of the case. Operation 1, illustrated in Fig. 22, is the facing of the flange surface that is 1 in. wide. The work is held by a four-jaw chuck in a Davis turret lathe, turning at a speed of 630 ft. per min. The facing tool *A*, held in one of the turret faces, feeds at 0.019 in. per revolution. The second operation, the drilling of eight ¹³⁄₆₄-in. holes through the cover, is handled on a Baush multiple-spindle drilling machine as shown in Fig. 23. The work is held in the jig by two clamps. The jig is turned over after being loaded, the drills entering from the opposite side. The drills operate at 60 ft. per min. with a 0.01-in. feed, using a soda-water compound.

Two ⅜-in. holes are drilled in the third operation, shown in Fig. 24. The work is held by two clamps *A* and located by two studs that fit into the previously drilled holes. The jig is of the index type revolving on a bearing that is set at an angle of 35 deg. with the base. The first hole, 3½-in. deep, is drilled, the jig indexed and the second hole 2⅝-in. deep is completed as shown in Fig. 25. A counterbalance *B* is provided to offset unbalanced weight of the jig. The locking pin for the indexed positions is located in the rear of the fixture.

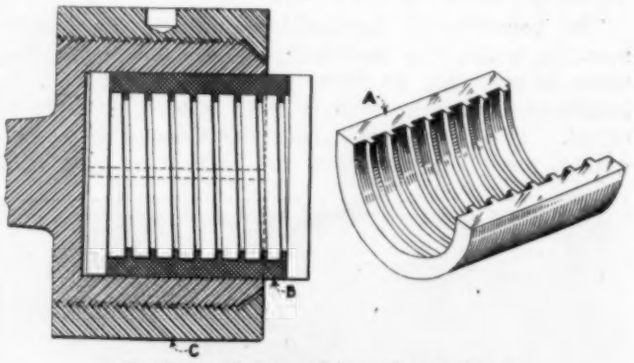
The final operation, straddle milling two lugs to 2.392-2.387 in. on a Cincinnati milling machine, is illustrated in Fig. 26. The work is located over two pins and held by the clamp *A* mounted on a pivot so that it may be swung out of the way for removal of the work. Two cutters, 8x1½ in., of the inserted-blade type are used, running at 520 ft. per min. with a 12½-in. feed. A snap gage *B* is used for checking the finished product, the tolerance being 0.005 in. The other covers used on the transmission case are stampings and require no machining other than press operations.

Cutting Airplane Starter Spring from Solid Metal—Discussion

By Arthur Silvester

The article by Paul T. Ash, under the title given above, published on page 538, Vol. 62, of the *American Machinist*, was interesting to me. Having had some experience in making similar springs, I am of the opinion that the methods described by Mr. Ash could be improved upon, and would suggest the following:

Turn the blank to size, without boring, and then mill the thread to the full depth. Make a liner of babbitt metal, in halves, to fit between the collars of the blank, as at *A* in the illustration. With the liners in place, as at *B*, hold the blank in a split chuck, as at *C*. If no split chuck of the proper size is available, an ordinary



Tools used in making the spring

lathe chuck will do. With the blank so mounted, proceed to drill and bore it to the inside diameter of the spring, thus setting the coils free and completing the job, as far as machine work is concerned.

While this method is the reverse of that described by Mr. Ash, it has the advantage of eliminating the danger of spoiling the spring in the milling operation. Furthermore the work is solidly and rigidly held from start to finish, and fast production can be maintained.

One pair of liners will last for a long time, providing they are carefully used. In casting the liners, if a little oil or graphite is rubbed over the blank, they can be removed quite easily.

Maintenance of Rolling Stock on New England Railroads

By Ellsworth Sheldon
New England Editor, *American Machinist*

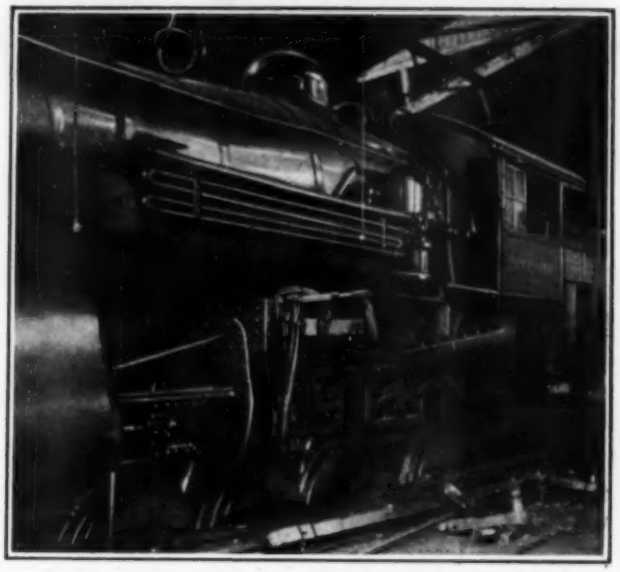


Fig. 1—Locomotive on drop table

A railroad shop of Northern Vermont—Making hub liners of boiler plate—Driving-box facings are made of fiber-board—An unusually fast boring job

THE Central Vermont Railroad, though now controlled by the Canadian National Railways, is entitled to be designated a New England railroad as its tracks lie almost wholly in three of the six New England states. Like many of the present-day roads in this section of the country it includes a number of smaller roads that, having met with disaster during the building or in the early years of operation, were passed over to a new and more securely financed corporation to be welded together into one larger unit.

The latest—and largest—addition to its lines was the New London & Northern Railroad, running from New London, Conn., to Brattleboro, Vt. With this road, now called the Southern Division, the line runs from New London on the shore of Long Island Sound to Richford and St. Johns, Quebec, on the Canadian border (broken from Brattleboro to Windsor, between which towns its trains run over the rails of the Connecticut River Division of the Boston & Maine) with several branches in Vermont. At St. Johns its tracks join those of the Canadian National. The Central Vermont operates 493 miles of track and its motive power and rolling stock consists of 105 locomotives, 2,508 freight cars and 118 passenger cars.

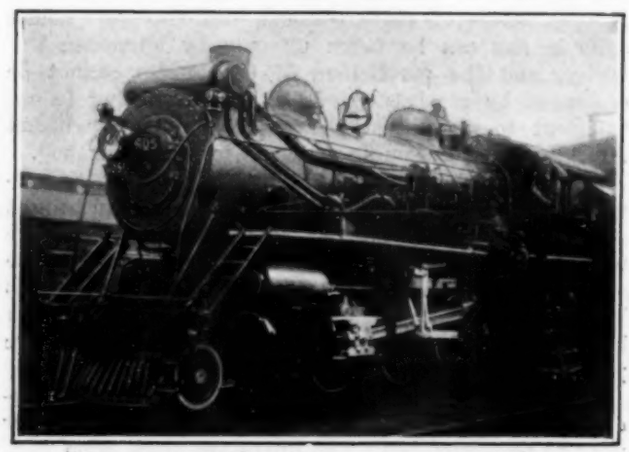


Fig. 2—Just out of the shop

Its main shops at St. Albans, Vt., were built in 1866, and notwithstanding the greatly increased size and weight of engines and other equipment since that time, these shops are still very well adapted to the work for which they were designed. Glass and steel were used much more sparingly in mill construction seventy years ago than now, and buildings of that period were not as well lighted nor as conveniently arranged as those of more modern design, but this disadvantage is far more than offset by the many mechanical and electrical aids now available.

One of the greatest handicaps to the St. Albans shops is that there are but two tracks upon which engines can be run in for repairs, and these tracks extend lengthwise of the buildings so that the position of a locomotive undergoing repairs cannot be changed so readily as when there are short tracks, each accommodating one engine, running crosswise of the floor and served by a transfer table. Six engines is the maximum number that can be handled to advantage at one time under the present arrangement of tracks.

The erecting floor is equipped with a drop table for the wheeling and unwheeling of locomotives and a 5-ton crane is provided to handle the driving wheels. Electric crane trucks, electric and air-hoists serve the machine tools.

Across the yards from the locomotive shop there is a 22-stall engine house, built but a year or two ago and of the most modern construction. It is unusually well equipped with machinery to handle the class of repairs that fall to the lot of the roundhouse shop, and is piped

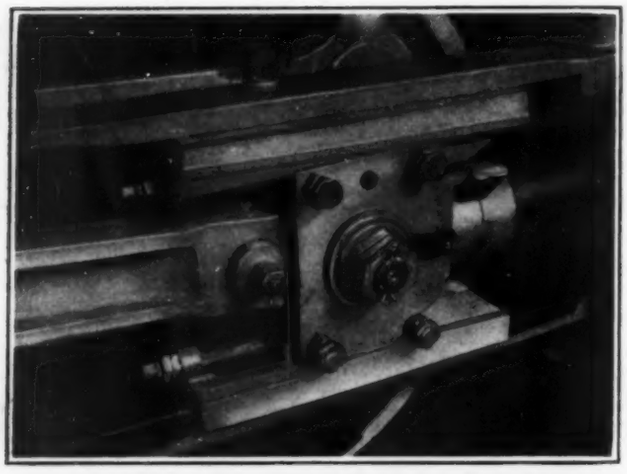


Fig. 3—The Rogatchoff crosshead

for oxygen and acetylene gases and compressed air, as well as for steam, water, etc., for the washout system.

A 200-ton Whiting hoist of the latest type in the back-shop provides means for unwheeling four- and five-pair-coupled engines. To handle one pair of wheels at a time there is a drop-pit in which the jack is operated hydro-pneumatically. A small air-driven pump mounted on the truck supplies the water pressure, and this gets its air from the shop mains through a flexible hose connection. Fig. 1 shows a consolidation engine over the drop table in the main shop with the wheels dropped, ready to be rolled out to the rear.

Car-shops, paint-shops, wood working mill and foundries are located across the street from the locomotive shops with tracks extending into them from the latter and also from the yards at the other end. Some of the buildings date from the same period as the locomotive shop, while the coach and paint shops are of the latest modern design, having been erected in 1924. All are well equipped with machinery and appliances for the class of work to which each is adapted and repairs are made to all of the company's equipment in these shops. The foundry makes all of the gray-iron castings and all of the brass castings except locomotive-journal and rod bearings that are used on the road.

The principal job in progress at the time of the writer's visit was the installation of feed water heaters upon the locomotives. The unit consists of a cylindrical tank, with circulating coils, that is carried across the top of the smoke box in front of the stack, and a compound, direct-acting boiler-feed pump, not unlike a Westinghouse air pump in appearance, carried on the left side of the boiler.

An attachment to the exhaust nozzle diverts a greater or lesser portion of the exhaust from the main cylinders so that it passes into the tank, where it surrounds the coils that conduct the feed water from the pump to the boiler. Water of condensation drains back to the tender, not only conserving the supply but assisting materially in keeping it above the freezing point in winter. Fig. 2 shows an engine that has just been brought out of the shop after having this equipment installed, being one of 13 engines so equipped this summer.

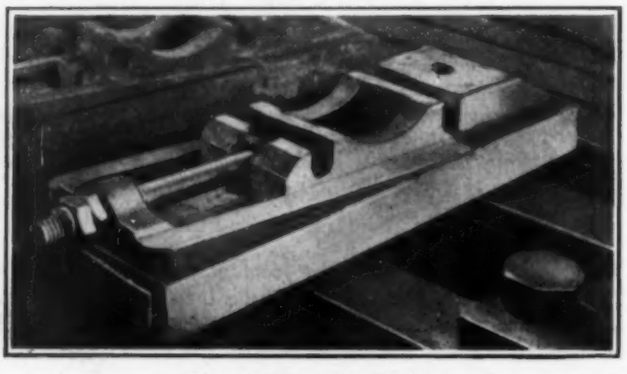


Fig. 4—Crosshead shoe

Another innovation that is being applied to the engines of this road as fast as they come in for general overhauling is the Rogatschoff crosshead, shown in Fig. 3, the feature of which is its adjustability to compensate for wear. From this illustration and from Fig. 4, which shows the crosshead shoes and the adjustable steel wedges, an idea of the principle may be gained. The screw and check-nuts enable the roundhouse mechanic or road repair man to make minute adjustments with ease and certainty, and eliminate the chance of binding the crosshead at one end of the stroke, as is likely to happen when the adjustment is made by shimming the guides.

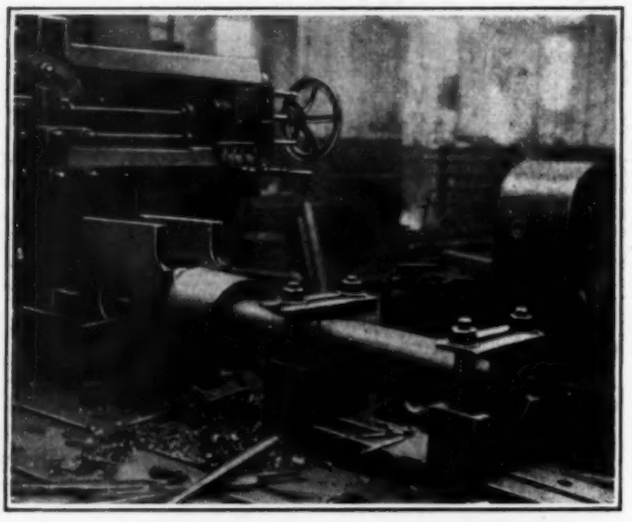


Fig. 5—Planing the crosshead

When these crossheads are applied in the shop, great care is exercised to align the guides accurately, after which they are "tacked" at each end to cylinder head and guide yoke, respectively, by means of the electric welding arc, so that they cannot thereafter be moved. Any slackness of the crosshead that may be evident after a run can be taken up only by adjusting the wedge, and the parallelism of the guides cannot be destroyed by careless shimming. The welding is not sufficient to prevent its being broken apart without difficulty when the engine returns to the main shop.

The body of the crosshead must be planed to correspond to the included angle of the wedge, and to hold it in the planer for this purpose, as well as to insure that all crossheads shall be alike in this respect, the set-up shown in Fig. 5 is employed. The crosshead is keyed to a dummy rod and the latter is held in V-blocks by bolts and straps. The bottoms of the V-blocks are planed to the desired angle.

The electric welding process is also employed to secure hub liners to the driving wheels when the latter need to be resurfaced. The liners are made from $\frac{3}{4}$-in. boiler plate, bored and turned to the requisite diameters,

Fig. 6—Pair of wheels prepared for welding liners

after which they are cut in halves. Holes are drilled through them and countersunk from one side to facilitate attaching them to the hub of the wheel, and the periphery of a complete liner is beveled in four places.

In Fig. 6 may be seen a pair of wheels prepared for welding the liners. The latter are first fitted to place and held temporarily in position by means of long jack-bolts set out between them. Metal is then built up in the holes and at the beveled places around the periphery, as may be seen in Fig. 7. No holes are drilled in the hubs, the metal being welded to the surface of the hubs as it is built up in the countersunk holes of the liners.

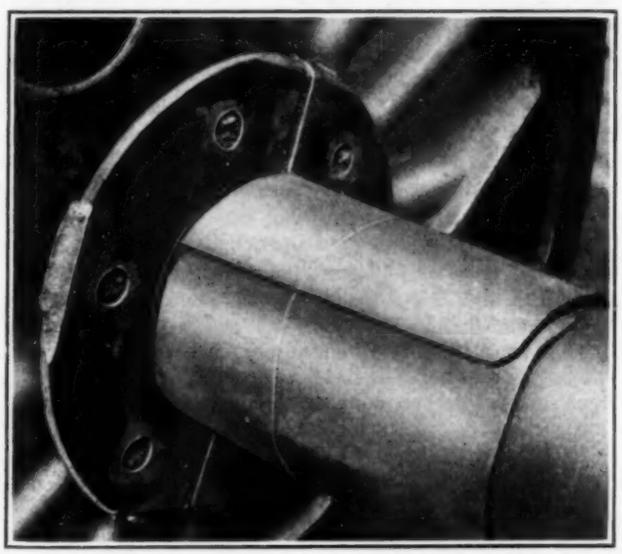


Fig. 7—Boiler plate hub liners welded on hub

The holes in the liners are not filled to the top, but are left just as here shown, which represents a completed job so far as the welder is concerned.

The sheet of metal that may be seen wrapped around the axle is to protect the journals from possible injury while the welding is being done. When the wheels go to the lathe the liners are faced off and turned on the diameter to make a smooth job. The welding is intended to be just sufficient to hold the liner to the hub in service, but not to prevent its easy removal by means of chisels and wedges when the same pair of wheels need to be refaced.

Bronze, babbitt and even steel are commonly used in railroad shops to face driving boxes where they bear against the wheel hubs, but in this shop they are faced with fiber. This material is said to give little, if any, trouble in service, and to be unusually long-lived. The facings are cut out on a bandsaw from a sheet of fiber board $\frac{3}{8}$ in. in thickness and after being applied to the boxes are machined in the same manner as would be a facing of metal, which means, usually, that they are faced off in a boring mill.

A templet of sheet metal is laid on the fiber board, and marked around with a pencil, after which the board is sawed to line. In laying off the facings the templet is reversed for each alternate piece so that the outlines are interlocked and as little of the material wasted as possible. Permanent jigs, made of boiler plate with steel-bushed holes, are used to drill the facings for attaching them to the boxes.

The fiber facings are fastened to the boxes by means of round, parallel plugs of bronze that are fitted to the holes and driven through the fiber into corresponding holes that have been drilled in the box. The reason for the drilling jig, or templet, is to locate the holes in the fiber facings so that a box, once having been drilled for the purpose, may be refaced again and again as necessary without having to plug old holes and drill new ones. The brass plugs are driven into the holes until they bottom, whereupon continued driving causes them to expand so tightly that the fiber board is held permanently in place until worn out.

Many freight engines on this road are fitted with the Southern valve gear. This type of gear, shown in Fig. 8, is a logical development from the Walschaert gear, having the characteristics of quick valve opening and of accessibility that render these movements superior to the older Stevenson type and allow the cumbersome, and often troublesome, eccentrics and straps to be discarded. There is no connection between the levers and the crosshead as in the Walschaert gear, and the link is no longer a link, as it is stationary. Sliding the block from one end to the other by moving the Johnson bar merely changes the position of the fulcrum lever with relation to the other members of the gear. The motion of the valve is derived through the usual reach-rod from a return crank upon the end of the main pin, as in all gears of this type.

The link block is bushed with hardened steel, as are the various rods and levers. The fulcrum pins are hardened and ground, so that wear is reduced to a minimum and replacement made easy. Though the number of moving parts in this gear is not smaller than in the Walschaert, their weight, as well as the amplitude of

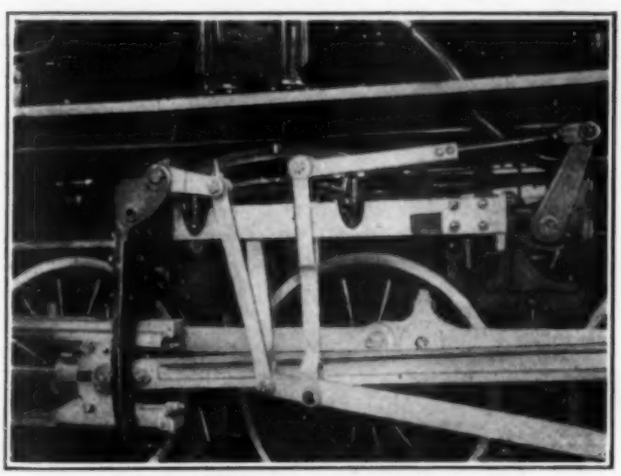


Fig. 8—The Southern valve gear

movement of many of them is less, a condition that might reasonably be expected to reduce the wear upon the pins and bushings.

A job on which remarkable time is made is the boring and facing of brass journal boxes for freight cars. These are half-boxes, of various sizes, according to the car in which they are to be used, and must have a roughing cut taken over the bore as well as a smooth facing cut on the flanged ends. Before they are put into service the bore is lined with babbitt so that the bored surface does not have to be made smooth.

The boxes are bored, two at a time, in the jig shown in Fig. 9 on a Bullard vertical turret machine. As the bore is not a full semi-circle the boxes do not bear against each other when placed in the jig, but against vertical keys set into the side walls of the latter. Screws, actuated by the large handwheels to be seen upon either side of the jig, hold the work pieces against the keys with sufficient pressure to resist the thrust of the boring tools.

The boxes bored at the time this observation was taken were for 5½x10-in. journals—that is, they were 10 in. long about 3 or 3¼ in. in radius, due allowance being made for the babbitt lining. The boring was done with a double-end tool, carefully ground to divide the work between the two ends. A double-end scraping cutter, keyed into the same bar that holds the boring tool, faces the upper ends of the brasses after the boring tool has passed through the hole.

The position of the saddle on the cross-rail is not changed, the operator having only to manipulate the control that runs the slide up and down, throw the power feed in or out as occasion requires, and to bring the facing tool down by hand just far enough to secure a clean, smooth surface. The table is then stopped, the handwheels turned back to release the work, the boring tool withdrawn and the bored boxes exchanged for others.

The machine runs at 60 r.p.m., the power feed is ⅛ in. per revolution, and the depth of cut—divided between the two cutting lips—about the same amount. The actual time of the operation is uniformly 1 min. 56 sec. from floor to floor for each loading of the jig; 58 seconds per piece.

The foreman of the machine shop, under whose direction this jig was made, has a theory about machining brass that, while it may not be unique is surely unusual. He says that if a tool is made sharp enough to *cut* off the metal it will break down under a heavy cut. "Make the tool sturdy enough to *break* off the metal, and apply the power; if the tool does not break the metal will."

This theory was demonstrated upon a brass casting in the vise of a big and powerful Morton shaper. The test cut was 1 in. deep, with a feed of ⅛ in. per stroke.

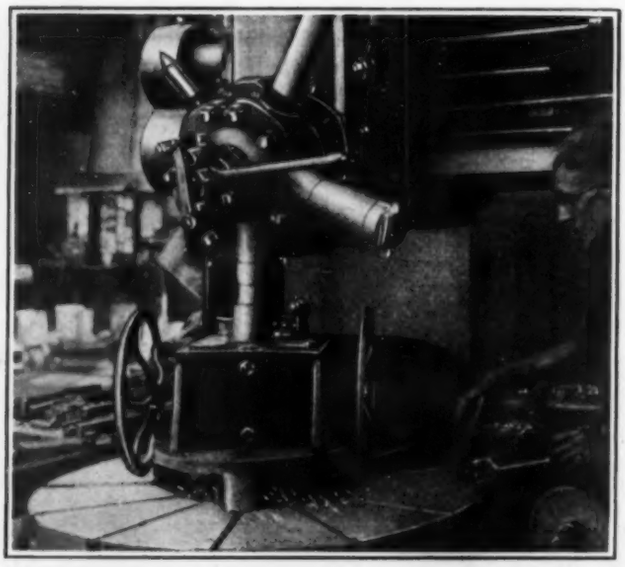


Fig. 9—Jig to bore car journal boxes

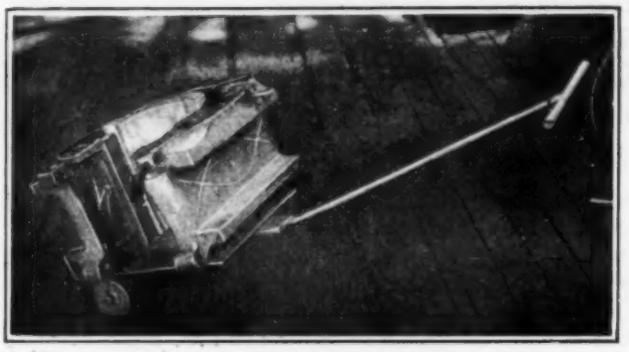


Fig. 10—A shop-made truck

Though the hot chips flew around in a manner somewhat disconcerting to the observer, neither the machine nor the tool evidenced any signs of lying down on the job.

A driving box for a locomotive is just a little too big to carry around the shop by hand and not quite big enough to justify calling a crane to transport it, so a helper with an inventive turn of mind devised the little truck shown in Fig. 10. It is made of a bar of iron of rectangular section, drawn out round at one end where a short cross-bar is welded on for a handle. The other end is split, and the split ends turned outward to form an axle.

A sheet of metal with an upturned lip is riveted to the bar for a body, and a couple of wheels, retained by cotter pins, complete the job. It is a very handy implement with which to transport driving boxes, and when it is not in service it will stand upright of itself, in a corner or elsewhere, instead of lying across the floor where the handle is a menace to the feet of the unwary.

Calibrating Pressure Gages

In calibrating pressure gages, the gage should always be placed in the position it will occupy in service, says the Bureau of Standards.

This matter recently came to the bureau for attention in connection with the testing of gages for Mullen paper testers, which are machines for determining the bursting strength of papers. An inquiry was received as to the position in which the gage should be calibrated, that is, whether in a vertical or horizontal position, the latter being the position when in use. The bureau has found in calibrating pressure gages of essentially similar principle that there is a considerable difference in the results obtained with the gages in a vertical position as compared with the horizontal.

The change is explained by the difference in distribution of friction of the moving parts of the gage mechanism in the two positions and difference in the effect of gravity on some of the parts. It is necessary, therefore, to calibrate Mullen paper tester gages in a horizontal position to obtain correct results.

Welding All-Steel Automobile Bodies

By Joseph W. Meadowcroft
Superintendent, Edward G. Budd Manufacturing Co.

Importance of electric spot welding in manufacturing—The welding personnel—Apprentice instruction—Spot welding practice — Special construction of welding electrodes

IF WE were to turn back a score of years we should find relatively few commodities produced from light-gage sheet metal and that almost all fabrication was by the riveting method which caused much difficulty. Rivets were not driven tight. The rivet holes were over or under size. The heads were offset and there were numerous other objections. Much stress, therefore, was laid on the importance of finding a method of fabricating sheet metal products which would yield a more substantial and economical product.

Electric spot welding is the method which has replaced riveting and this fabrication has been applied very successfully because the welds are strong and production is large with lower cost and cleaner operation and at the same time the capital investment in tools and the maintenance cost has undergone a notable reduction.

During the early days of electric spot welding of sheet metal, much difficulty was encountered because manufacturers of sheet metal failed to hold the material to a uniform gage. Consequently, the manufacturers of electric spot-welding equipment had to build machines which would work by mechanical control in the switch, applying both power and pressure.

While this development work on welding machines was in progress many steel mills were attempting to roll sheets so that they could be held commercially uniform in order to give us a material and a method of fabrication suitable for use in the construction of railroad coaches, airplanes and automobile bodies.

When designing the various parts of all-steel bodies, much stress is laid on the method of welding to be applied and a strict standard is adhered to at all times. The size and construction of the various types of bodies produced for the many automobile companies plays a very important part in the amount of welding but the average number of welds on open-type bodies is as follows:

1,000 to 1,100 electric spot welds
70 to 80 in. of acetylene-gas welding
10 to 12 in. of metallic arc welding

On the full-vision, all-steel sedan bodies, the average number of welds is as follows:

1,600 to 1,700 electric spot welds
170 in. of acetylene-gas welding
11 to 12 in. of metallic arc welding

The various stampings are forged in dies and assembled in electric welding machines of our own design, which have many special attachments so that we can weld all parts or units together and hold them uniformly. With these special fixtures we are able to hold all contour parts in the proper position while welding them. They also insure safe and sound welds. We are able to make sufficient allowance in the special welding fixtures for expansion and contraction which so frequently is a source of trouble in welding large bodies of metals together. Regardless of the method of welding used in connection with the assembly in these machines, no time is lost in the manufacturing operations because each operator does his particular part, finishing with his helper or helpers within a specified time.

Another feature of economy in production on these specially built welding machines is that the welding operators get the highest efficiency in the assembly and welding of the various parts of the body since the stampings or parts are interchangeable. Many operations are done on conveyors, regardless of the method of welding used, without any loss of time in the operation.

All the various parts of the body are clamped together to insure good contacts in making the spot welds, and the clamping is very important so as to eliminate indentations in the metal. On some unexposed interior parts, the indentations receive no consideration, but in every case we make proper allowance for the contraction of the metal at the point of welding so that the bodies are held in their proper shape and to their proper dimensions. Fenders and accessories are, therefore, interchangeable.

18,000,000 Spot Welds per Day

In our daily production, 18,000,000 spot welds are made and the copper dies are designed under the supervision of the welding division, held to certain standards for shape and size of material and produced in quantities in the tool department. A stock of each copper die is kept in the tool booth in each assembly department so that a quick change can be made at any time. However, only a small supply of each die is kept in stock so that the inventory of copper is small regardless of the vast amount of electric welding done.

Due to the amount of electric spot welding done in our production it is necessary to train a large number of men. The qualifications of applicants for work as resistance-welding operators are as follows:

1. Age—18 to 25 years.
2. Posture—Quick.
3. Hands, legs and feet must be in good condition.
4. Eyesight must be in good condition.
5. Schooling must be through the grammar grades at least.

Most of the welding is done on metal ⅛ in. in thickness. The operator must be able to adjust his machine

Abstract of a paper presented before the American Welding Society, Oct. 22.

in such a manner as to insure standard spot welds. The daily production per machine per man is between 10,000 and 25,000 according to the size of the pieces to be welded. The mechanically-operated machines produced 150 to 175 spots per minute. Men with mechanical experience or those who have worked around machines are preferred. Electric-resistance spot-welding operators are more or less leaders in production, setting the pace for related operations, and it is essential that active, alert and ambitious men be employed.

Apprentices are from the first instructed very thoroughly as to the safety devices and tools required to be worn and used. A careful selection of clothing is made, for if an operator should wear an old torn shirt, coat or any piece of clothing that is in any way ragged, it is apt to become ignited and cause a very bad burn. We strongly disapprove of the use of cotton garments or those that contain a mixture of more cotton than wool since the author has seen a number of operators catch fire from sparks or flying molten metal falling upon a fuzzy shirt or apron. The regular grade of blue woolen shirt commonly worn by workmen is about the safest garment than can be worn.

The operator wears an apron of leather of a size to protect him from a point high on the chest to the knees and well around the waist toward the back. The operator is instructed to wear his apron at all times and not to permit it to become oily without having it washed or replaced with another apron.

Much stress is also placed on the selection of goggles. We have found that they should be constructed to be adjustable for the proper distance between the eyes and it is also necessary for comfort that the part which is used behind the ear, the temples, should fit properly. The goggles should be well ventilated but at the same time they should have the side shields and they must be so adjusted that there are no crevices around the outside edge for the sparks or molten metal to enter between the face and the goggle.

Instruction on Spot Welding Machines

After the apprentice is equipped properly, he is instructed as to the construction and use of the spot welding machines. He learns how to prepare a die or electrode and to assemble them into water shanks or die holders. He is then instructed how to adjust the electrode holder so that the upper and lower electrodes or dies are placed in alignment. He is also impressed with the fact that he should never strike an electrode or die with any hard substance to align them, since the copper is soft and the threads are apt to become loose and leak.

The apprentice then receives instructions on the following:

1. How to attach special accessories to electrodes so that they can be used on two or three welding operations.
2. How to file electrodes to the proper diameter to correspond with the gage of metal to be welded.
3. What action to take when the electrodes heat up in operation.
4. The proper care of the locks on the water-shank holders, using the proper size of wrench to lock them.
5. What action to take when threads on electrodes begin to wear.
6. Why he should never use dirty and blunt dies.
7. Why the regulator switch should never the changed while in the operation of welding.
8. Why no material of any kind should be placed on the transformer in electric welding machines.
9. Why water tubes should always be placed ½ in. from the end of electrodes.
10. Why rusty or scaly material should not be welded.
11. Why it is necessary to have the water-shank holders held firmly in the water shanks.
12. Why he must watch connecting wires on the switch.
13. How to assemble contact plugs.

The six basic causes for repairs on spot welding machines are:

1. Insufficient or improper lubrication.
2. Presence of dirt on the bearing surface.
3. Misuse of the machine.
4. Imperfect adjustments.
5. Vibration.
6. Unavoidable wear.

As each man finishes his training he is placed under the supervision of a welding foreman who is responsible for the quality and quantity of the work turned out by the apprentice. They are advanced from time to time in accordance with their ability and since all operators are paid in accordance with the class of work they are doing there is always a goal to work for and to encourage further efforts.

At various time periods the welds are inspected while they are being made instead of after they are finished. In this way the inspector can also assist the welding operator to become more efficient in obtaining a production output satisfactory in quantity and quality.

How a Low Spot Is Formed

When two metal sheets are spot welded together in accordance with the customary practice, the fusing of the metal and the pressure applied results in the formation of a low spot weld. The thickness of metal at the weld is slightly less than the combined thickness of the two overlapped sheets in an unwelded portion. This difference in thickness is not very great but where a finish is to be applied to the surface of one of the sheets, it is objectionable since these low spots give an undesirable appearance to the finished surface.

In some cases where spot welds are made on radii, it is possible to spot weld metal sheets together in such a manner as to cause part of the metal at the weld to protrude above the surface of the surrounding metal by forming a small teat or projection at the weld. They can then be removed in any suitable manner such as grinding in order to level them with the surrounding surfaces. This new surface then has no low spots and its appearance, when finished, will be desirable.

The lower electrodes, in our practice, are of the standard form and the upper electrodes are of the usual form except thay they have a small conical recess in the lower end of the electrode. The metal sheets are inserted between the electrodes having the recess. The electrodes approach each other and engage and clamp between the overlapped sheets, the electrical circuit being closed so that the current flows from one electrode to the other through the sheets. The heat generated causes the metal to fuse at this point. The fused metal is forced into the recess of the electrode and forms a small projection on the surface to be finished. A low spot will also be formed at the weld in the exposed surface of the sheet but it is not objectionable since this surface is not to be finished. In the usual spot welding operation such low spots are formed in both exposed surfaces. These weld projections in our process are removed by grinding or filing. This method avoids the expense of grinding down the surface to meet the low spots.

Winning the Foreman's Help

By Hugo Diemer
Director Industrial Courses, LaSalle Extension University

Existing attitudes toward industrial relations and personnel policies—Winning the foreman's help in promoting satisfactory industrial relations—Things the foreman can do

INDUSTRIAL relations and personnel policies, with their accompanying methods, have undergone the severe test of deflation and retrenchment. The attitude toward them and their disposal during the past five years may be summarized as being at the present time of three kinds:

1. Their complete abolishment. 2. The abolishment of the personnel department but retention of certain policies and practices accompanied by a redistribution of these activities and methods, depending upon the works manager and office manager to carry out the policies which were generally followed by the personnel department. 3. The maintenance of the personnel superintendent and staff with such curtailments as the situation demanded, but with sufficient force to function completely as a line organization and department in employment and having the head of the personnel work function as a major staff official.

The reason for the complete abolition of personnel and industrial relations activities and staff by some companies has been due to two causes:

A. Financial embarrassments so severe as to make curtailments which the management recognized were temporarily disadvantageous with the hope that with improved finances the activities could be reinstated. B. The assumption that personnel work may be used as an umbrella—useful in times of great production activity and labor scarcity, but to be dispensed with under all other circumstances as a superfluous luxury.

The second procedure, namely that of abolishiing the personnel department as such but endeavoring to retain its policies and methods, has had as its causes a combination of reasons: The desire for economy on one hand, coupled on the other hand in many instances with the fact that the existing staff and its head were too professional in their attitude and not sufficiently in touch or tune with the production organization.

The third situation, that in which the personnel and industrial relations staff has been maintained intact, is the condition which prevails among the small minority of strong and well-managed corporations that have been able to weather the depression and that are today among the first to realize early profits from the return to normal conditions.

It will be rather generally acknowledged that the first and second conditions prevail in by far the great majority of industries. Among the more progressive of these industries, executives and officials are giving considerable thought to the early reinstatement of personnel activities. It is fairly well agreed that understanding on the part of the foremen is one of the vital necessities in the success of all personnel work, whether this work is controlled by a staff department or is considered a regular production function. How can we secure this co-operation and make it most effective?

How Foremen Can Help in Improving Industrial Relations

Employment	Employee Service	Education and Training Work
Determine labor needs from manufacturing program	Interest employees in:	Adapt experiences or training of new employee to job
Keep in touch with possible employees	a. Health work	Train men on new jobs
Accept new employees and approve their rates	b. Benefit association	Co-operate in promoting interest and attendance in:
Introduce new man to job and fellow workers	c. Savings plan	a. Special plant schools
Recommend:	d. Suggestion system	b. Outside educational activities
a. Transfers or discharge	e. Social, recreational, or athletic activities in the plant	c. Libraries and trade and technical publications
b. Promotion or change of rate	f. Company store	Promote right thinking in working force
Supply job specification information	Report sickness of employee or family	Advance self through:
Approve changes in day or piecework rates	Supply department news to shop paper	a. Plant schools
Apply labor policy	Refer employees to service department for legal advice	b. Correspondence schools
Conciliate grievances	Co-operate in promoting charitable or patriotic campaigns	c. Private reading and study
Maintain interest in accident prevention	Co-operate in carrying out routine	d. Taking active part in foremen's meetings
Co-operate in carrying out routine		Co-operate in carrying out routine

In all this service work the foreman has an active part; in some plants he takes active direction of many of these activities as they affect his department. In any case the foreman must co-operate with the other departments and work hand in hand with them. Otherwise, how can the employment and other departments know how they can best serve the production departments and thus exercise their function of promoting efficient plant operation?

Most foremen will admit that centralized hiring is a great relief to them. There will, of course, be a few who will have hailed with pleasure the return to a condition where they can build up a little personal political machine by hiring their own men and in this way, through their autocratic domineering of their men, make less likely the discovery of their own mistakes and delinquencies. There will be other foremen, also, who will be skeptical of the ability of an interviewer to select the kind of men they want. I have found, however, that when we get under the skin of these skeptics they will agree that the best service in any line can be given by specialization. It is important that the interviewer or interviewers "sell" themselves to the foremen. When they have once sold themselves on the basis of good fellowship and manhood, there is usually very little difficulty with regard to foremen's co-operation.

The foreman is likely to be skeptical as to the motives behind any kind of service work and as to its efficacy. Usually the most vulnerable spot in this opposition is struck if we give him real, good cooking in the company cafeteria. If we get him to be satisfied with the cafeteria food and service and serve it at a moderate price we can go further and convince him that the management is not doing this for the purpose of showing how philanthropic it can be, but because it has been found to be one of the best ways of protecting the health and strength, and thereby the efficiency of employees, who otherwise would be compelled to eat a cold lunch at the bench or go outside to buy poor, higher-priced and indigestible food. I advise every company that is conducting a cafeteria or contemplates doing so to see that it has a good cook, good food, good service and reasonable prices. Success or failure in the cafeteria has much to do with success or failure in winning the good will of the foremen. Once the foreman is satisfied with the cafeteria meals, he will agree that anything that is done to prevent disabilities which swell the list of absences and tardinesses is good policy.

Statistics Are Convincing

Next in securing the foreman's good will is prompt and effective service in furnishing candidates for vacancies. When it comes to preparation and submission of comparative department statistics on labor turnover, I have found that it is usually quite easy to convince those foremen that have good records and low turnover that it is profitable to keep the figures low. On the other hand, the worst offenders, among foremen who have high turnover records, are apt to be those who are most skeptical as the reliability of figures which show a high cost for breaking in new men and loss of material due to high departmental turnover. Patient and repeated discussion of fact-presenting statistics, together with clearance analyses of men who have left these foremen's departments, if tactfully conducted, will win them over.

There are certain foremen of the hard-boiled type, however, for whom there is no remedy except the big stick applied in no uncertain manner by the works manager. To get this big stick applied means that the works manager and department manager must be sold on the idea of reducing labor turnover in the departments of the hard-boiled foremen. If the manager happens to be of the type that prides itself as being of the hard-boiled type, and secretly laughs with the hard-boiled foremen and scoffs at the figures of labor turnover, the situation is a very difficult one. This situation exists today far more widely than the average general manager or president suspects. In these cases the higher officials have a distinct duty to perform in educating the works managers or superintendents to a realization of the money value of human engineering.

In the matter of job analysis and job specifications, the foreman can give valuable suggestions and help. He will do so if the purpose of the investigations and their use are clear to him and if he is in sympathy with and likes the man or men making the investigations. It is usually quite practicable to have the investigations made by the employment interviewer or interviewers during the latter part of the week. It is practically the universal experience that almost all applicants for help apply during the first three days of the week. This fact makes it possible to devote Thursday and Friday afternoons and part of Saturday morning to the making of job-analysis and man-specifications investigations by interviewers. Here again the understanding and co-operation of the general superintendent or works manager is very important.

A Question of Policy

In my experience as personnel superintendent in a factory which was so large that it employed some five or six production superintendents, there was one of the production superintendents who objected to interviewers going into the shop, and wrote a letter to the works manager in about the following words: "I believe one of the objects of the investigation is to secure better contacts between the personnel division and the foremen. The personnel division should make its contacts through the production officials. It would seem that there is already sufficient contact provided by having the personnel superintendent present at the weekly production conferences."

The particular production superintendent who wrote that note controlled about one-third of production of the plant and took the same stand toward a proposal of the personnel department to conduct foremen's conferences for the purpose of training them in the fundamentals of foremanship. He claimed that it was undesirable for the foremen to have contacts with anyone outside of the immediate line executives in production for the purpose of discussing such matters as policies and methods. When the superintendent was convinced that the president of the company was in favor of both the job-analysis investigations and the foremen's conference he went through the motions of acquiescing. Unfortunately some of the foremen in this particular superintendent's group of shops continued to maintain their superintendent's original attitude, which was that he did not want any new ideas brought in or discussed. The apparent acquiescence with the plan when it was backed up by the company president, but accompanied by a large mental reservation of secret opposition, constituted a difficult problem and a typical one, as I have discussed it since with many other personnel men.

After all, in most cases the basis of the opposition of production superintendents is the fear of the loss of a tight grip which they think they have on their foremen. Their conception of control usually includes very little outside of autocratic military and disciplinary methods. This type of superintendent usually has very little sympathy in the matter of transfer of employes who have been arbitrarily or unjustly laid off or discharged. Frequently such a superintendent is a man

of thorough mechanical or technical training and the general management hesitates to enforce personnel and industrial relations policies into active effect in his department. The failure to do so will be recognized by the superintendent as a sign of weakness on the part of the general management. No matter how busy the general management may be with financial or sales policies, successful industrial relations and personnel policies are so vital a cost factor in production that they are worthy of the necessary time and energy required to convert production superintendents of the type I have described. If the superintendents cannot be converted, the matter is so important, from the standpoint of company morale and production costs, that there should be no question about telling them in no uncertain manner that they must either fall in line or step out.

Most foremen will be glad to co-operate if approached properly, in seeing to it that the performance and efficiency records and rating cards of employees tell a complete and reliable story. Such records form a sound basis for the exercise of greater discrimination in the matter of advances and promotion.

In the matter of safety work, the foreman can, by opposition, lack of co-operation, or a plain "don't care" attitude, destroy a good safety plan or kill a safety-first spirit. He can work wonders, when he tries, in changing a work shop from a place of risk to one of reasonable security.

When it comes to athletic and social activities and benefit associations, there are many shops in which the foremen take very little interest. These foremen should be made cognizant of the fact that the foreman who does interest himself in this work gets a new slant—a new approach and hold on many members of his force through this interest—a hold that will be a great aid to him in securing co-operation for increased production, better quality, and lower costs.

An Important Factor

What is true of athletic and social activities is even more true in regard to educational and training work. The foreman who is interested in the development of his working force is likely to be interested in his own further development. By encouraging the men in his department to take up self-improvement work, by making frequent inquiries as to how they are getting along, by advice and co-operation in the work, and in many other ways, the foreman is an important factor in any employee training and educational program.

The accompanying tabulation lists in condensed form the personnel and industrial relation activities in which the foreman's understanding, sympathy, and co-operation are important factors. Every item is of sufficient importance to justify its discussion at the foremen's conferences. The best way to conduct conferences is to distribute in advance written or printed discussions of the subject. Then prepare a list of questions to stimulate thought and discussion. Pass these questions around to the foremen who are to take part in the discussion a day or two before the conference. Prepare charts in which the main points that it is desired to bring out are listed. These discussions can be advantageously carried on simultaneously with or subsequent to the conduct of a general training course in the fundamentals of foremanship under the guidance of an experienced leader.

Seen and Heard

By John R. Godfrey

Why men are leaving the machine shops

More and more of my friends are talking of the problem of getting men for the machine shop. One of them, who has to do with placing men and boys in the metal industries, puts the uncertainty of employment high among the reasons that men and boys are seeking other fields. Add to this the difference in wages and you have two very strong reasons for a scarcity of good men, even at a time when most metal working shops are nowhere near capacity.

It is claimed that comparatively few men today who leave the machine shop ever go back to it. And the same applies to the foundry. I know of two cases where men have refused to go back after having been laid off. Foundry helpers earn more by digging sewers and they are in the open, work a shorter day and avoid the heat and gas of the foundry.

One case is that of a foreman in a good shop who was laid off on account of work being slack. He got a job as foreman of a contractor's gang, gets more money, works less hours, has less responsibility and enjoys the work. In another case a foreman of good standing, one of the key men in a small but good shop, quit to drive a motor truck, at more money and less responsibility.

Boys who would like to go into the shop during summer vacations find it difficult to get an opening. Machine shops do not seem to want to bother with them for two or three months. And if they do, they offer them less than they can get jerking soda water in a drug store.

The boys seem to have little difficulty in tying up with a contractor or in some building lines, and at very attractive wages. The result is that the boy is weaned from his leanings toward the shop, and the industry frequently loses a boy that would have been a credit to it. Can the metal working industry afford to continue along such lines?

Even now, many shops are having a hard time to get enough good men. What will happen when a real demand comes for the machines they build?

When it comes to the question of unemployment—to the fear of being laid off, no individual can do much. And just how much an industry can do remains to be seen. The garment industry here is trying a sort of insurance plan—in England it's a government dole that has many drawbacks. Just what the answer is no one seems to know, but its worth thinking about at least.

I can't help comparing it in a way to accident compensation. It isn't so many years ago when the poor devil who got hurt stood all the expense. Then we gradually adopted workmen's compensation. And after it began to cost us real money when a man got hurt, we woke up to accident prevention and safety first. We've done a lot to save life and injury since then in many ways.

Isn't it just possible that if we hit the pocket book nerve hard enough through some sort of unemployment insurance, some bright idea would crop out that would smooth out at least part of the ups and downs in business? If it *paid* everyone to buy in a fairly steady fashion, wouldn't we find a lot of high and low spots disappearing?

How can it be done? Some one wiser than J.R.G. will have to answer.

Book Reviews

The Gasoline Automobile—Its Design and Construction—Vol. IV, Fuels and Carburetors. By P. M. Heldt. Three hundred seventy-eight pages, 5½x8 in. Published by P. M. Heldt, Nyack, N. Y. Price $5.

This is the first edition of this volume, making the fourth and presumably the last to be added to the series by this well-known author, who is one of the pioneer engineering writers in the automotive field. In this volume he takes up not only gasoline, which is practically the only fuel we know in this country, but also kerosene, benzol and alcohol as well as mixed or blended fuels.

Carburetors are treated in detail, both as to their construction and also as to the way in which they should be adjusted and repaired. Fuel tanks and feed systems as well as air cleaners are described, while the theory of combustion and deterioration receives careful attention. The volume is a fitting companion to the three that have preceded it.

Manual of Organon; the Philosophy and Science of Organing; the Art of Management. By Charles W. Gremple. Thirty-two pages, 4x7 in. Limp leather covers. Published by the Organon Lyceum, 181 Bleecker St., New York City. Price $2.

The book is divided into three parts: Prolegomena; Organon; and Organing. All three consist of statements of generalities, many of them being quotations. Just what the author is trying to do remains something of a mystery after a careful reading. Perhaps there is valuable information concealed by the phraseology, terminology, typography and punctuation, all of which are peculiar, but it is not apparent in one reading.

A. S. T. M. Standards Adopted in 1925. One hundred and twenty pages, 6x9 in., paper bound. Published by the American Society for Testing Materials, 1315 Spruce St., Philadelphia, Pa. Price $1.50.

This book comprises the first supplement to the 1924 book of standards which is published triennially. Thirty-eight new standards are published in the book following their adoption by letter ballot.

These specifications include non-ferrous metals, cement, lime, gypsum, clay and miscellaneous materials. A few line drawings are included in order to bring out the new specifications more clearly.

Materials Testing. By Irving H. Cowdrey and Ralph G. Adams. One hundred twenty-five pages, 5x8½ in., clothboard cover. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York, N. Y. Price $1.50.

The volume deals with the study of fundamental stresses and strains of materials and the methods of determining various properties so that specifications can be formulated. Principles that are basic and fundamental, lending themselves to widest application, are given. The contents will aid in determining the various physical properties of materials and in conducting tests to determine whether or not products fulfill desired specifications as well as a study in the behavior of materials to ascertain strength, points of weakness and distribution of stress under working conditions.

The contents are intended as a text to accompany a laboratory course in the study of materials. No attempt has been made to outline any particular set of tests but rather to lay before the reader principles on which specifications are based. The most common types of tests are included, omitting the special types that are narrow in their application and used by more advanced students and specialists. The methods employed in the study of tension, compression, torsion, bending, hardness determination and shock and repeated stress are given. Highly technical descriptions and formulas have been eliminated, enabling the average layman to quickly grasp the requirements of these tests.

A brief description of testing machines is given, including general principles involved. A chapter on fractures of metals and their significance is included, strongly impressing the importance of the study of fractures to determine characteristics of metals. In another chapter is discussed the three outstanding methods of testing the hardness of materials. The limitations and precautions necessary in their use are pointed out in addition to their comparative relation. Testing methods for cement, sand and timber also are shown.

The book should be of value as a reference to those who want a condensed treatise on material testing.

Foreign Commerce and Navigation of the United States for the Calendar Year 1924. Eight hundred and seventy-eight pages, 9x12 in. Cloth bound. Published by the Department of Commerce, Washington, D. C. Price $2.

The report on the commerce of the United States contains an explanation of the tables and statistics included in the volume. These tables cover the total values of exports and imports of merchandise for the years 1910 to 1924. Monthly reports and tables for the percentage of foreign trade by groups of merchandise are given in full and in summary form in order to facilitate reference.

The number and tonnage of vessels entered and cleared in the foreign trade are listed by customs districts, nationality and countries.

The style and general arrangement of the bulletin follow the usual practice for government documents.

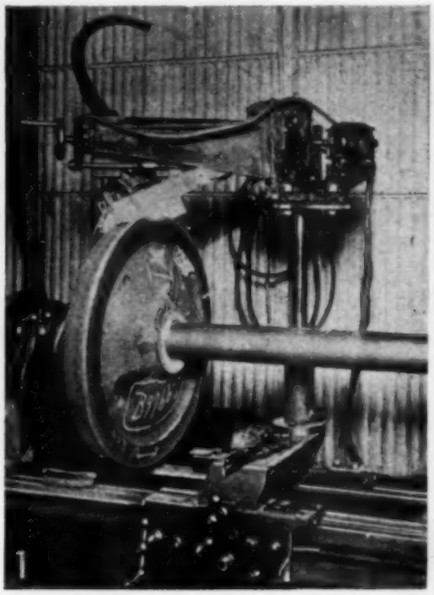
National Directory of Commodity Specifications, 1925. Miscellaneous Publication No. 65 of the Bureau of Standards. Three hundred and eighty-five 8x11-in. pages, cloth bound. Published by the Department of Commerce, Washington, D. C. Price $1.25.

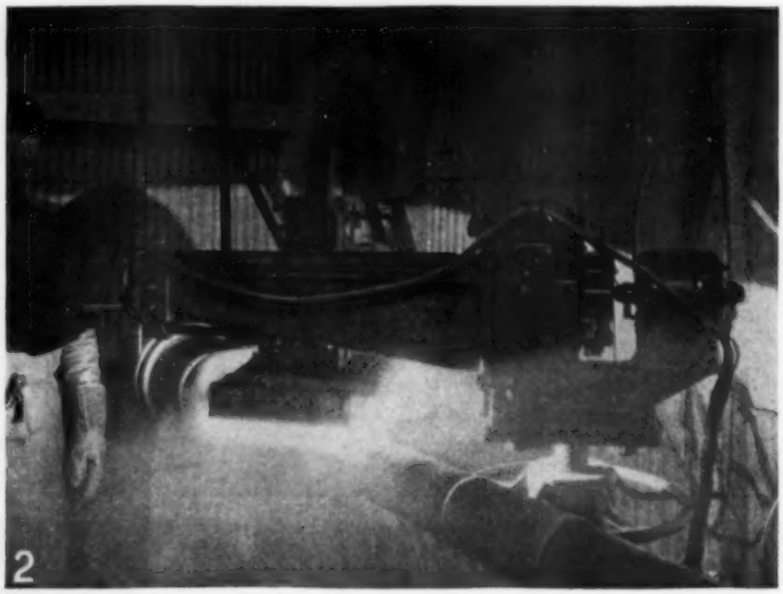
This volume of commodity specifications contains classified and alphabetical lists and brief descriptions of existing standards set up by the governmental departments and large purchasing organizations that require material uniform in quality.

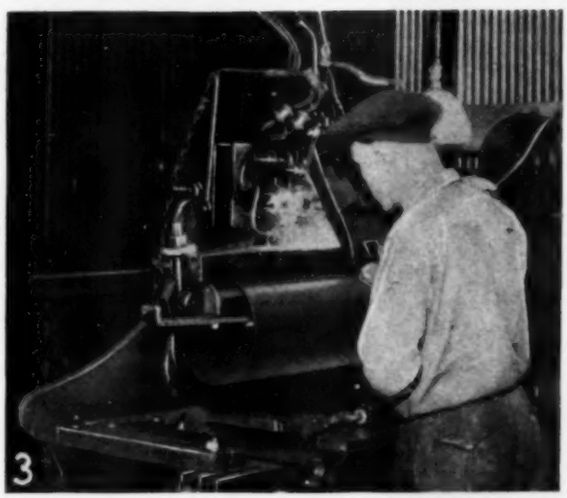
The commodities are classified according to the decimal system and, therefore, methodically divided and subdivided. Under each subdivision is a list of the larger organizations with the numbers of the circulars describing the standards of each organization.

The table of contents is an index to the decimal system adopted, while the index itself is a list of the more than 6,000 commodities included in the work, and gives the decimal number assigned to each subdivision.

The volume is a very useful list of the organizations publishing standards for nearly every conceivable material.







Arc Welders at Work

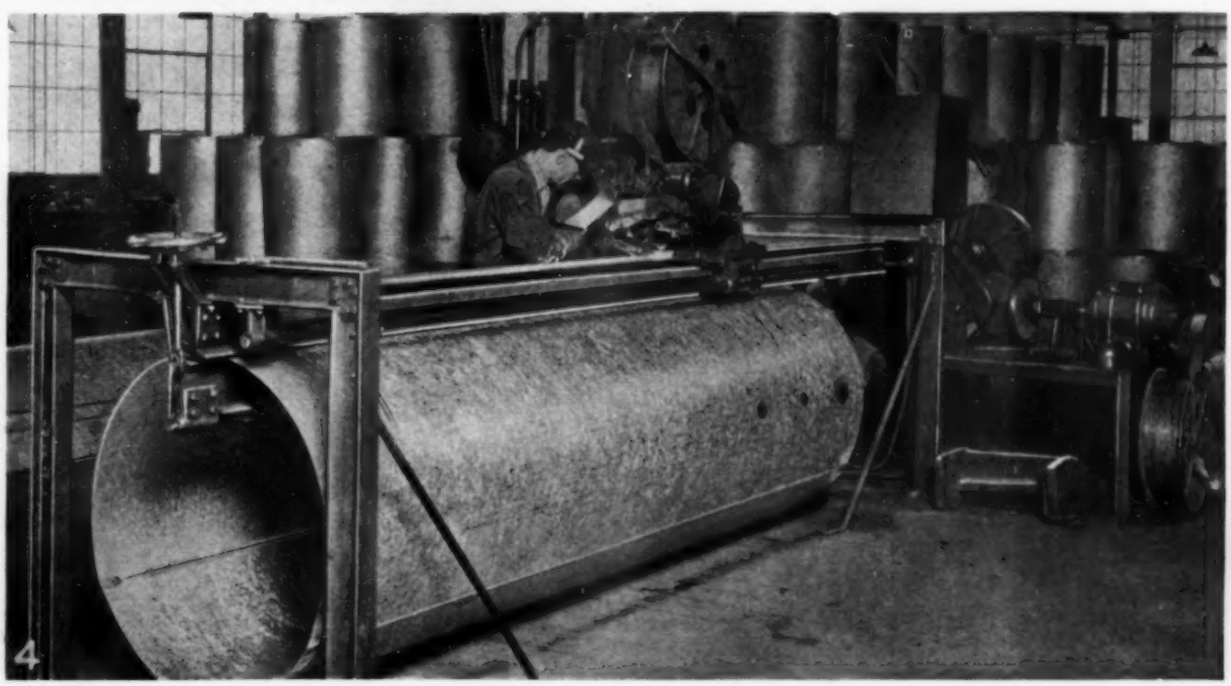
1—Rebuilding worn car-wheel flanges

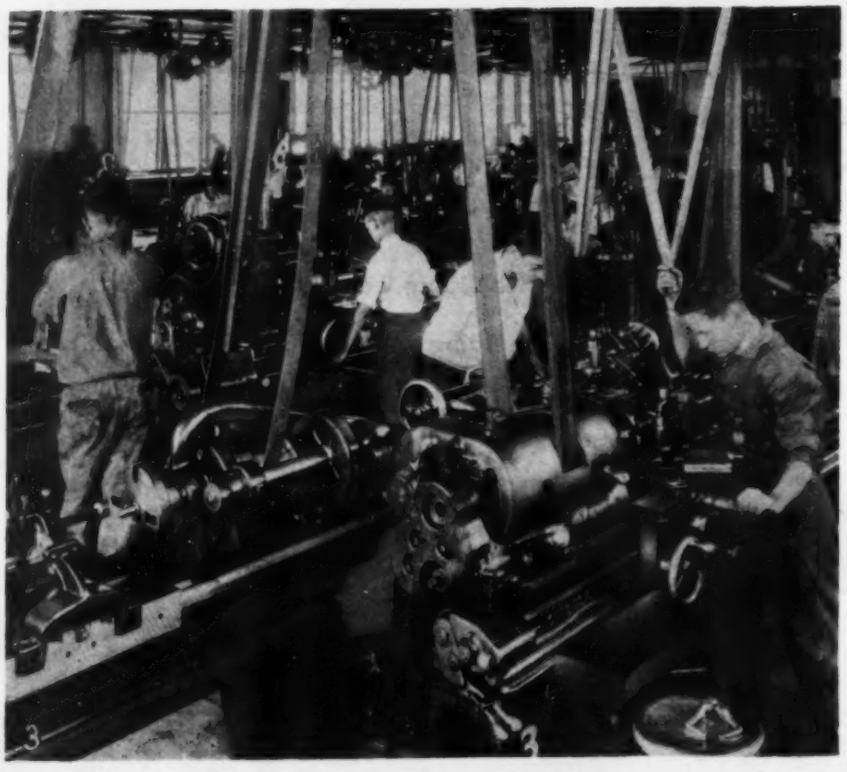
2—Building up worn journals of car axles

3—Automatic welding of ice-cream cans

4—Welding long tank-seams automatically

Photographs by courtesy of the General Electric Co.





Where Boys Learn

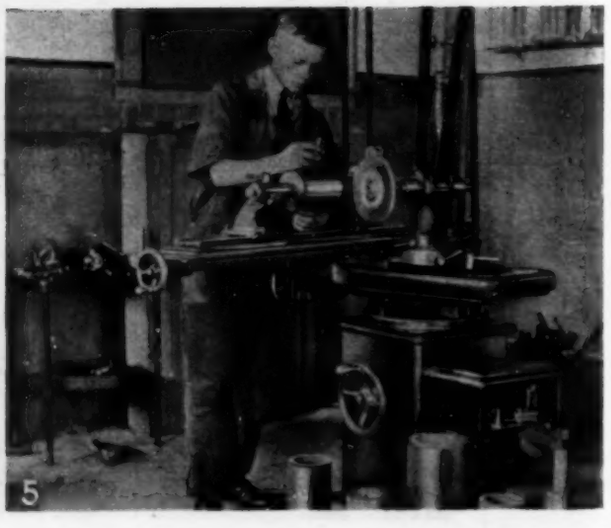
1—The Drafting Room

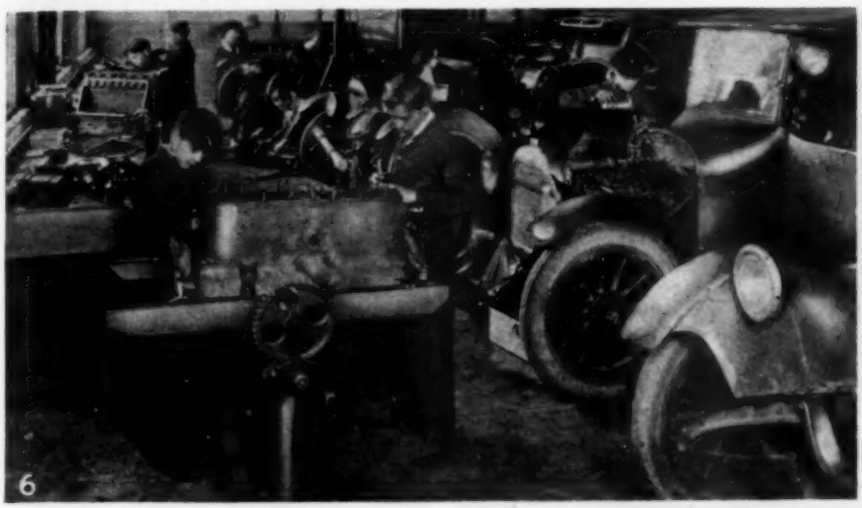
2—Pattern and wood work

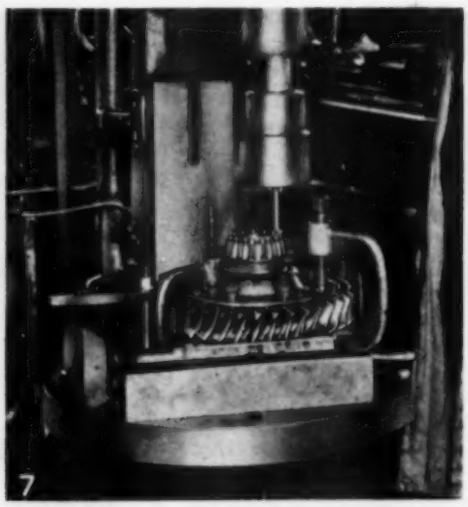
3—The lathe department

4—Fitting a nut to a square-thread screw

5—Cylindrical grinding







Practical Shop Work

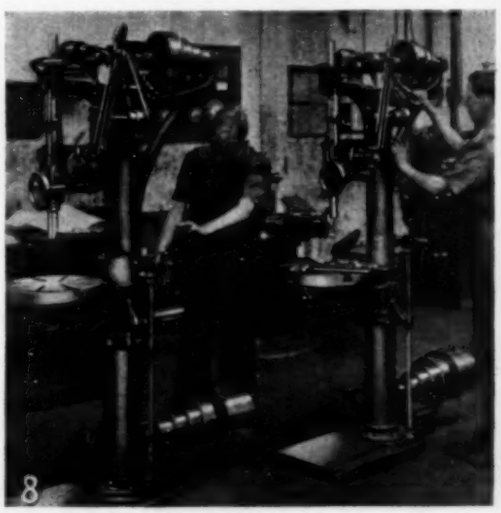
6—Automobile repair shop

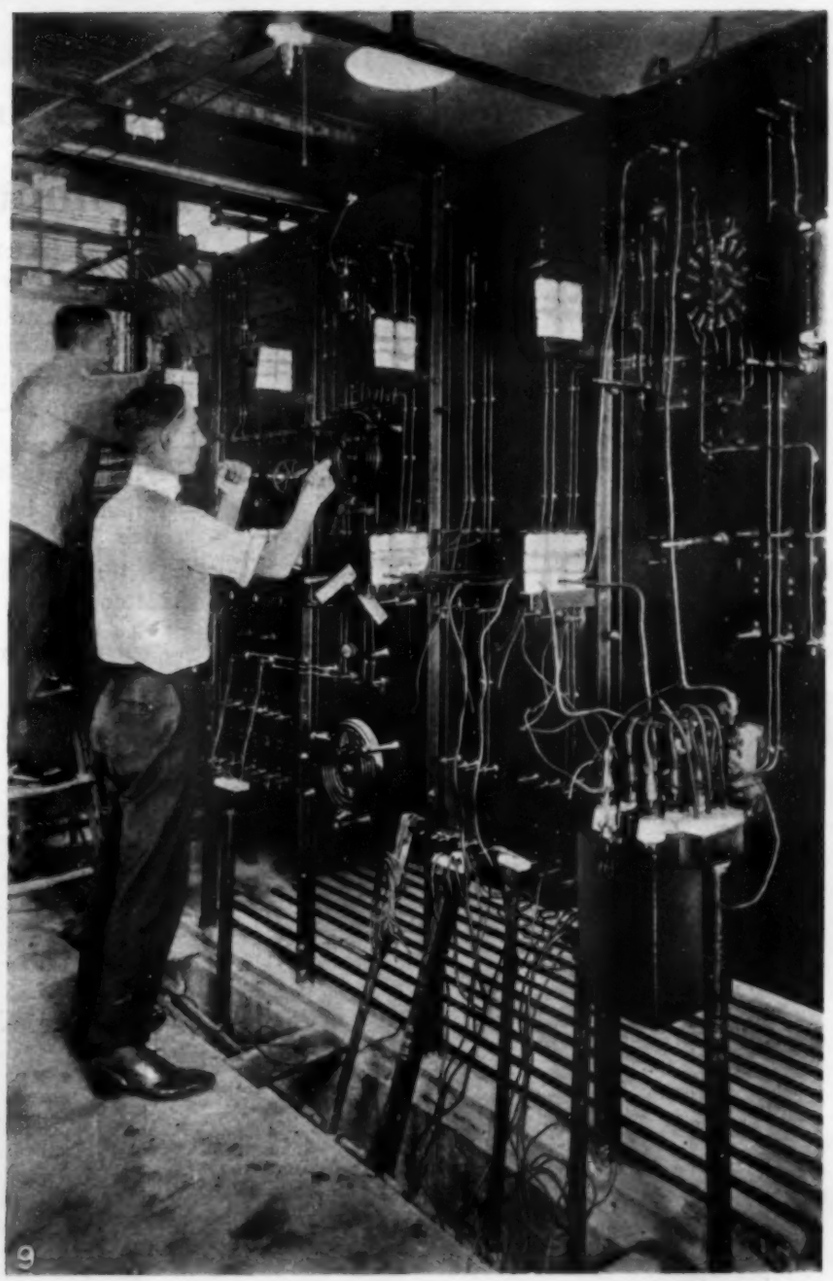
7—Repairing a truck worm

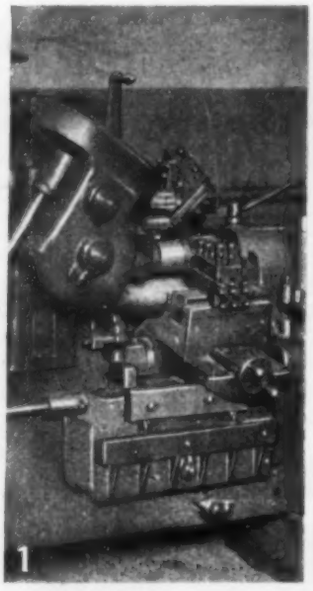
8—Drilling machines built in the shop

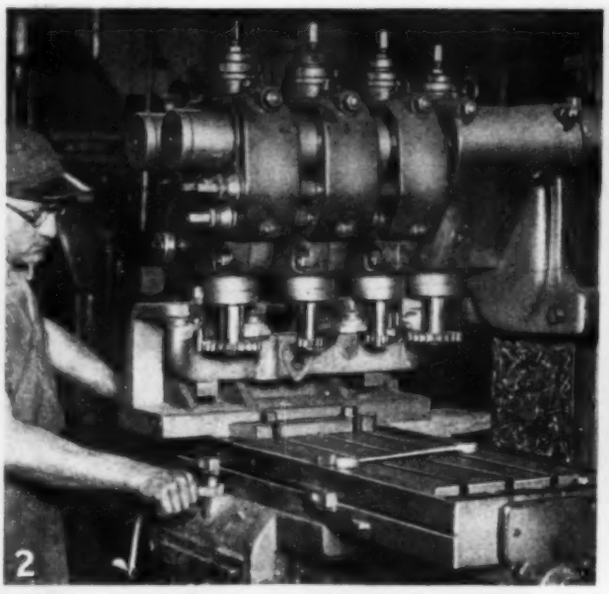
9—Large switchboard erected by students

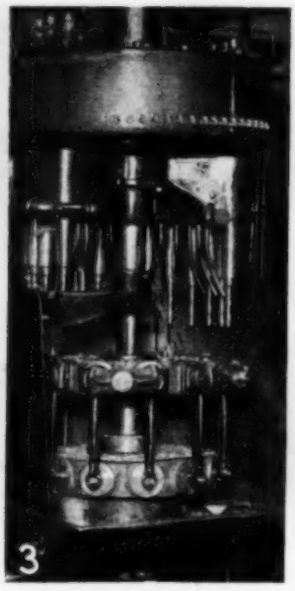
State Trade School, New Britain, Conn.

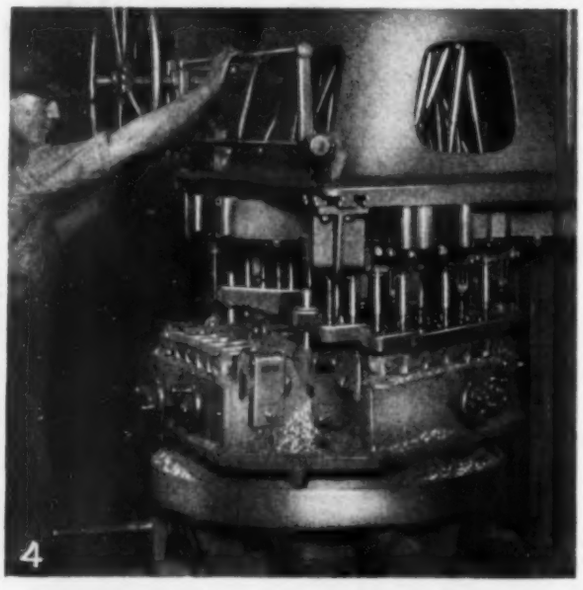












Some Present Day Automotive Methods

1—Turning pistons—grooving with circular tools—Fay

2—Milling manifolds on standard Milwaukee machine

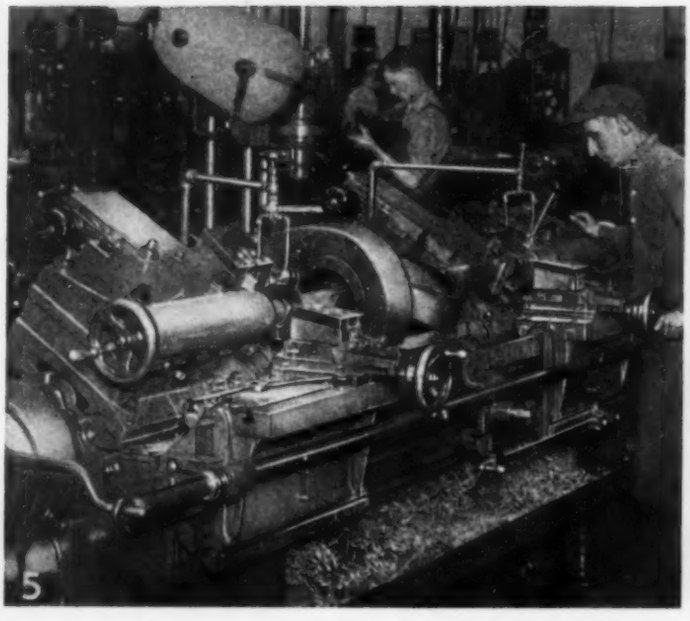
3—Station type drilling machine for connecting rods—Moline

4—Simultaneous drilling and reaming of cylinder heads—Natco

5—Finishing both axle-housing ends at once

6—Drilling the flanges of axle housings—Natco

Photographs by courtesy of the Ajax Motor Co.



Gear Tooth Loads

By Earl Buckingham

An elementary treatment of the various factors that enter into gear-tooth loads, such as torque, horsepower, pitch-line velocity

IT IS always a great help to the solution of any problem to be able to visualize the different factors that must be dealt with. It is also a very common habit to use various equations and values from handbooks without attempting to visualize the relationship between the different factors involved. In the majority of cases, this makes no difference. Occasionally, however, the conditions involved may be somewhat out of the ordinary, and the use of such equations without a full realization of their import often leads to serious errors. The object of this article is to attempt to visualize the various factors that enter into gear-tooth loads, such as torque, horsepower, pitch-line velocities and so on.

It is obvious that the first step toward proportioning the gear teeth is to determine the loads that these teeth must carry. These loads are dependent upon the nature and amount of work that must be performed.

In the final analysis, the forces acting on or through gear teeth may be resolved into a series of levers. We will, therefore, first consider the relationship of forces and distances on a lever.

In Fig. 1 is shown a diagram of a lever with a force or weight *A* acting down against the lever at a distance *a* from the fulcrum, and a weight *B* acting down against the lever at a distance *b* from the fulcrum. If weights *A* and *B* are equal, the distances *a* and *b* must also be equal when the forces are balanced. If the weight *A* is double the weight *B*, then the distance *a* will be one-half the distance *b* when the forces remain balanced. In other words, the product of a weight multiplied by its distance from the fulcrum of the lever is always equal to the product of the balancing weight multiplied by its distance from the fulcrum. Assuming a lever of

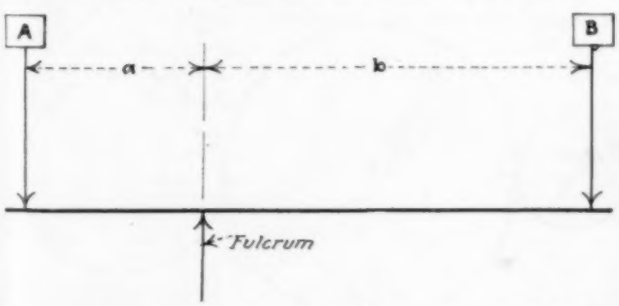


Fig. 1—Lever with forces A *and* B *acting at distances* a *and* b *from fulcrum*

no weight, the force acting against the fulcrum is equal to the sum of the opposing weights. As long as the weights are stationary, no work is done. Work requires motion.

A diagram of the same lever in two positions, indicating a movement of the weights is given in Fig. 2. When the lever is moved, the weight *A* is moved a distance *c* and the weight *B* is moved a distance *d*. These distances are always proportional to the distances *a* and *b*. Ignoring friction, the work done is equivalent to lifting the weight *A* to a height *c* or the weight *B* to a height *d*. Here again the product of the weight *A* multiplied by the distance *c* is equal to the weight *B* multiplied by the distance *d*.

When a shaft and bearing are substituted for the fulcrum of the lever, the foregoing conditions still hold true. Thus we have the following:

The weights *A* and *B* are the *forces* acting on the lever. These forces are usually measured in *pounds*.

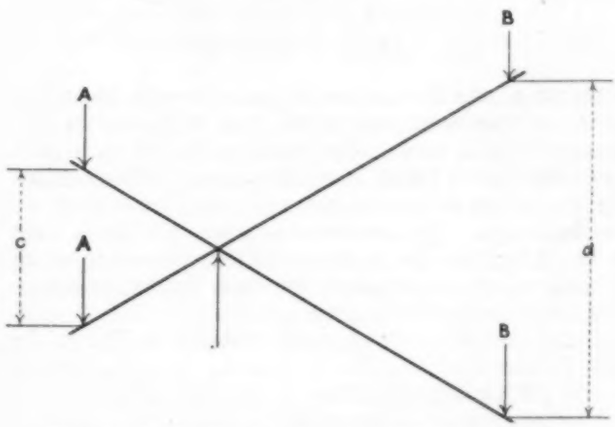


Fig. 2—Indicating a movement of the weights shown in Fig. 1

The product of the weight *A* multiplied by the distance *a* or the weight *B* multiplied by the distance *b* is the *torque* on the shaft which replaces the fulcrum. These torques are usually measured in *"inch pounds torque"* or *"foot pounds torque."* An "inch pound torque" is the turning moment of a weight of one pound at a distance of one inch from the fulcrum, while a "foot pound torque" is the turning moment of a weight of one pound at a distance of one foot from the fulcrum. One "foot pound torque" is therefore equal to twelve "inch pounds torque."

The product of the weight *A* multiplied by the distance moved, or the weight *B* multiplied by the distance it has moved is the *work* done. This is usually measured in *"foot pounds."* A foot pound is the work done in lifting a weight of one pound to a height of one foot.

The more work that is done in a given period of time, the more the *power* that is required. Or if the same amount of work is done in a shorter period of

time, more *power* is required. The power is measured by the amount of work done in a given period of time, such as *"foot pounds per second," "foot pounds per minute,"* or *"horsepower."* One "foot pound per second" is equal to sixty "foot pounds per minute." One horsepower is equal to 33,000 foot pounds per minute or 550 foot pounds per second.

The force acting against the fulcrum of the lever becomes the *bearing pressure* when a shaft is substituted for the fulcrum, and is measured in *pounds.*

A pair of gears is nothing more than a combination of levers, the forces or weights being applied through the gear teeth. These teeth are of such shape that the

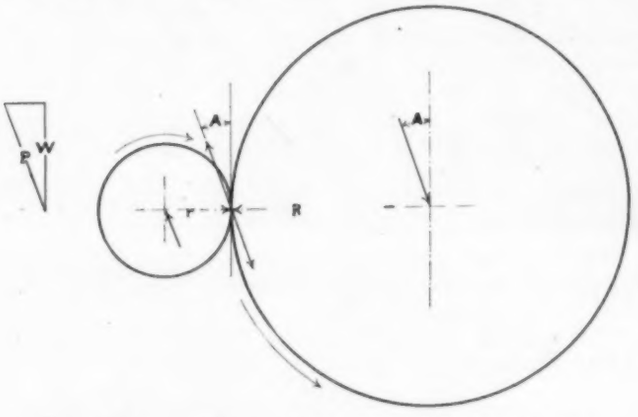


Fig. 3—A pair of gears, showing analogy to levers

moments of the forces always pass through the pitch point, or the point where the two pitch circles are tangent to each other. The pitch radius of each gear thus becomes the length of the lever arm. When analyzing the forces acting on gears we may treat them as simple levers. The pressure between the teeth acts at an angle; thus the moments of these forces must be determined exactly the same as when the forces acting on a lever are applied at an angle.

A diagram of a pair of gears is shown in Fig. 3. In this illuustration

r = pitch radius of pinion
R = pitch radius of gear
W = tangential force, or tooth load
P = pressure on gear teeth
A = pressure angle of gear

From the right triangle representing the moment of the forces of which P is the hypothenuse and W is one leg, it is seen that $P = \frac{\cos A}{W}$.

When r and R are equal, the gears will revolve in opposite directions at the same speed. When r is one-half R, the smaller gear will revolve twice as fast as the larger. The pitch-line speeds of the two gears will always be identical, however. The pitch-line speed is the circumferential velocity of any point of the pitch circle, and is usually measured in *feet per minute.* When V = pitch line velocity in feet per minute, and

r.p.m. = revolutions per minute.

$$V = \frac{2\pi r \times \text{r.p.m.}}{12}$$

In the above equation, $2\pi r$ equals the circumference of the pitch circle in inches. Multiplying this by r.p.m. gives the pitch line velocity in inches per minute. Dividing by 12 reduces this value to feet per minute.

When a pair of gears is required to transmit a given amount of power at a given speed, the following equation is used to determine the tooth load:

$$W = \frac{33{,}000 \times \text{hp.}}{V}, \text{ where}$$

W = tangential load in pounds
Hp. = number of horse power to be transmitted

In the above equation, the number of horsepower is multiplied by 33,000, which gives the number of foot pounds of work per minute that is to be done. Dividing this value by the velocity in feet per minute at which the gears are operating gives the load in pounds on the gear teeth.

The torque in inch pounds on the pinion shaft is equal to $W \times r$. The torque in inch pounds on the gear shaft is equal to $W \times R$.

In the case of a single pair of gears, the tooth pressure P is also the bearing pressure. The foregoing covers the loads on a single pair of spur gears.

We will take as a definite example a pair of spur gears that must transmit 10 hp. The pitch diameter of the pinion will be 4 in., the pitch diameter of the gear will be 16 in., the pinion revolves 2,000 r.p.m. and the pressure angle of the gear teeth is 20 degrees.

$r = 2.0$
$R = 8.0$
$A = 20$ deg.
hp. = 10
r.p.m. = 2,000 (for pinion)
r.p.m. = 500 (for gear)

Solving for V we have

$$V = \frac{4 \times 3.1416 \times 2{,}000}{12} = 2{,}094.4 \text{ ft. per min.}$$

Solving for W we have

$$W = \frac{33{,}000 \times 10}{2{,}094.4} = 157.5 \text{ lb.}$$

The torque on the pinion shaft equals 157.5×2, equals 315 inch pounds torque.

The torque on the gear shaft equals 157.5×8, equals 1,260 inch pounds torque.

The pressure P on the gear teeth equals $\frac{157.5}{\cos 20}$ equals 167.7 lb. The bearing pressure on both gear and pinion shafts is also equal to 167.7 pounds.

The speed of the pinion is 2,000 r.p.m. The gear ratio is $\frac{1}{4}$, this being the ratio between the diameter of

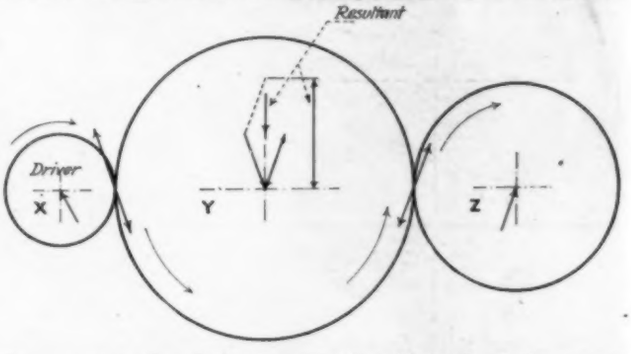


Fig. 4—A train of three gears in which all of the power applied at the driver is transmitted through the other two

the pinion and that of the gear. The speed of the gear is therefore $\frac{1}{4} \times 2{,}000$ which equals 500 r.p.m.

Except for the bearing pressures, the same analysis

as shown for a pair of gears is used for ordinary trains of gears. The bearing loads on intermediate gears of trains must be analyzed individually. In Fig. 4 is shown a train of three gears with their centers in a straight line. We will assume that the first two gears, *X* and *Y*, are the same as those of the preceding example, transmitting the same power at the same speed. The gear *Y* is an idler, transmitting the power from gear *X* to gear *Z*. In effect it is a lever, loaded at both ends. The tooth pressure *P* is the same at both ends, but is applied in the different directions as shown. The resultant bearing pressure is vertically down and is equal

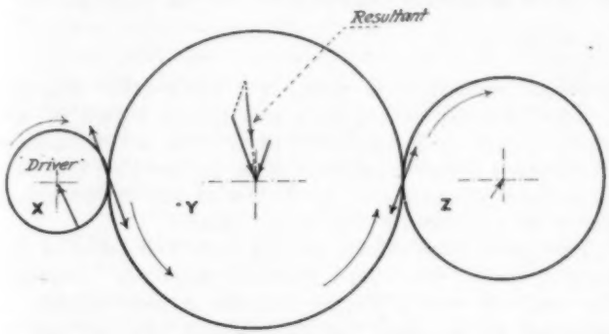


Fig. 5—Same train as in Fig. 4, but with only half the power applied at the driver reaching the third gear

to twice the tooth load *W* or 315 lb. The bearing pressures on the gears *X* and *Z* are both equal to 167.7 lb. The directions of these pressures are as shown by the arrows in the sketch.

As a second example, we will assume that the gear *X* is driving as before, but that the gear *Y* transmits one-half the power to its shaft and that the remaining half is transmitted to the gear *Z*. The tooth pressure between *X* and *Y* remains 167.7 lb., but the tooth pressure between *Y* and *Z* has been reduced to 83.8 lb. These pressures are shown diagramatically in Fig. 5. The resultant direction and amount of the bearing pressure on the gear *Y* must be determined by solving the oblique triangle of which 167.7 is one side, 83.8 is another side, and 140 deg. (twice 90 — 20) is the included angle. The resultant bearing pressure is 238.1 lb. at an angle of about 7 deg. from the vertical. The bearing pressure of gear *X* remains the same as before, while that of gear *Z* is reduced to 83.3 pounds.

For a third example we will assume that gear *Y* is driving gears *X* and *Z*, transmitting 10 hp. to each of them, or a total of 20 hp. The tooth pressure at both meshes will be 167.7 lb., but it is applied to gear *X* in a direction opposite to that in the first example, and in the same direction to gear *Z*. In this case the two bearing pressures on gear *Y* will neutralize each other, reducing the load to zero. The bearing pressures on gears *X* and *Z* will each be 167.7 pounds.

It should be evident from these examples that the bearing pressures must be analyzed individually for any train. When the centers of the gears are not in the same straight line, the resulting bearing pressures must be determined from the combined moments as in any other case of several forces acting simultaneously in different directions.

In all of the foregoing, the factors of weight and friction have been ignored. In most ordinary cases these can safely be ignored, as the weight of the gears is usually small in comparison to the weight of the other moving masses, and the friction losses in gears are usually such a small part of the total losses. We have also considered only the uniform transmission of power from one shaft to another.

When these conditions change, however, these omitted factors must be considered, and the problem becomes more complex. For example, where intermittent loads are met, and the revolving masses must act as fly-wheels, the problem must be solved accordingly. Again, where differential trains are employed, both the tooth loads and pitch-line velocities build up in the train, although the actual transmitted loads remain relatively low, so that the friction losses in the gears themselves become a large proportion of the total losses. In these and other similar cases, a careful analysis of the forces should be made, treating the gears as simple levers, and introducing all other controlling factors.

The analysis of other types of gears, such as bevel and spiral gears, and worm wheels, is made in a similar manner. As such gears transmit power around corners, additional moments of forces must be considered. Yet in all these types of gearing, the same general relationship between forces, torque, work done, power, tooth load, tooth pressure, and bearing pressure holds true as for spur gears.

Commercial Drafting

By John F. Hardecker

On the way to an engineering society meeting, Jack Smith noticed that his fellow chief draftsman and friend, Bill Brown, was unusually quiet and contemplative. He was far from his usual jovial self and in due time he unburdened himself. "You know," said Bill, "I had quite a surprise this morning when the manager called me in and began to inquire about the special machine we were designing for the National Co. I had been rather proud of our progress on this design, and you can imagine my feelings when he showed me how easily a machine from the A. B. Co.'s line could be adapted to our special needs. I thought I was pretty well up on commercial machinery but here was one I missed entirely, and the manager had run into only through a chance conversation at the Country Club with the A. B. Co.'s secretary."

"Yes," agreed Jack, "that happens to all of us some time or other. I try to guard against it, however, by delegating some bright young draftsman who looks like a fixture to the task of reading all the advertisements in the technical publications we take. Of course, we all try to keep up with the articles in these publications, but we seldom find the time to look over the ads thoroughly. In this way, we are sure to have someone in the organization who is familiar with all the latest developments in the machinery field. Then before we start developing a new machine, we acquaint our commercial draftsman with our needs, so that he can check whether there is any machine available commercially which might be used or adapted. It insures not only a cheaper job, but what is far more important, it takes full advantage of the development work done by the commercial machine manufacturer, and doesn't start us out 'inventing' something, which has previously been worked out. It surely has saved us from such a situation as yours many a time."

Ideas from Practical Men

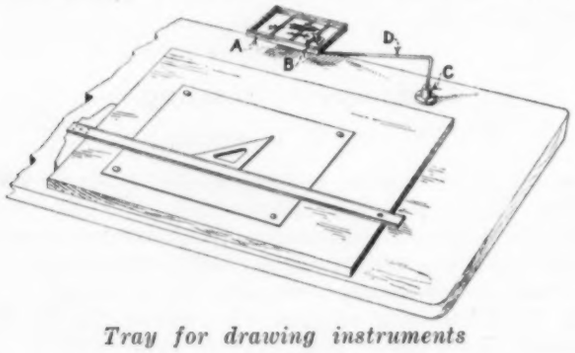
The department, "Ideas from Practical Men," is devoted to the exchange of information on methods useful to the machinery industries. Its scope includes all divisions of the machine building industry, from drafting room to shipping platform. Descriptions of methods or devices that have proved their value are carefully considered, and those published are paid for. The rates are from five dollars upward, according to their merit

Handy Instrument Tray

By H. S. Steele

As a usual rule, a draftsman's instruments are scattered over and around the board. Small triangles are lost among drawings, and compasses are often knocked off the board onto the floor and the points broken.

A handy device for holding instruments is shown in the illustration. It consists of the wooden tray *A*, about



Tray for drawing instruments

10x6x$\frac{3}{4}$ in., made of $\frac{1}{2}$-in. stock. Inside the tray are several small cleats, making it easy to pick up the instruments laid thereon.

On the bottom, at one end of the tray, is screwed a small socket *B*, in which there is a hole of the proper size to take a piece of $\frac{1}{2}$-in. pipe.

The pipe *D* is bent so that when the tray is assembled it will swing back and forth just a few inches above the top of the board.

The socket *C*, similar to socket *B*, is screwed to the table.

The tray will hold all the necessary instruments, and when not in use it can be swung out of the way either back or to one side of the drawing board.

Using an Air Hoist to Assist in Scraping Heavy Parts

By Henry Densmore

As everyone knows who has had occasion to scrape together the bearing surfaces of large and heavy machinery, the hard part is not the scraping but the rubbing together of the mating surfaces in order to show up the high spots that are to be reduced by the scraper. The bigger the machine the harder the job, and when the movable member approaches a ton in weight the expenditure of a great deal of physical force is necessary.

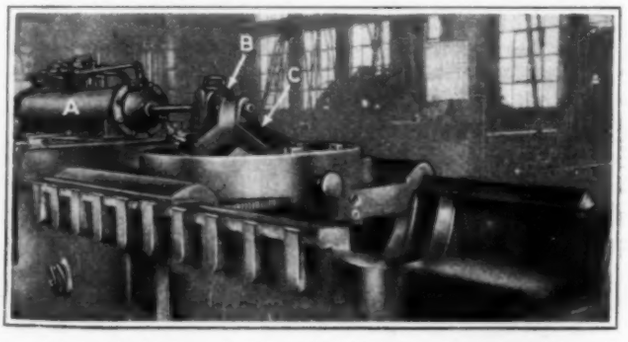
The workman who does the scraping must have in constant attendance a gang of "strong-arm" helpers, or else he must devise some mechanical means of applying power to the movable part. The accompanying illustration shows how it is done in the shops of the Blanchard Machine Co., by means of the cylinder and piston of a standard type of air hoist.

The parts here shown are the base and table of the largest size of Blanchard grinding machine. Brackets are made by which the air cylinder *A* may quickly be attached to the seat for the column, the surface of which has already been planed to receive the column itself. A simple loose coupling link *B* is employed to connect the end of the piston rod to a stud in the special yoke *C*, fastened inside the circular ways upon which the 60-in. rotary table is to bear.

Both the yoke and the brackets are so designed that they can be attached to the machine by a few standard bolts and setscrews without undue loss of time. Though the piston rod of the hoist cylinder must be brought approximately in line with the ways upon which the table is to slide, great accuracy in this respect is not essential, since the loose coupling will take care of a considerable degree of variation.

The reversing valve on top of the cylinder is in a position convenient to the workman, so that after scraping off the first high spots that appear, and applying red-lead paste to the surface, he can move the table back and forth over the ways as much as he chooses without greater effort than is required to move the lever of the valve.

Once the table is deposited upon the ways by the shop crane and the cylinder has been bolted to the base



Air-cylinder used to assist in scraping operation

of the column, the workman needs no helper. He can scrape the exposed surfaces, red lead them, push the table to the opposite end of the ways by applying the air pressure, and then scrape the newly exposed surfaces; repeating as often as necessary until he is satisfied with the job.

IDEAS FROM PRACTICAL MEN

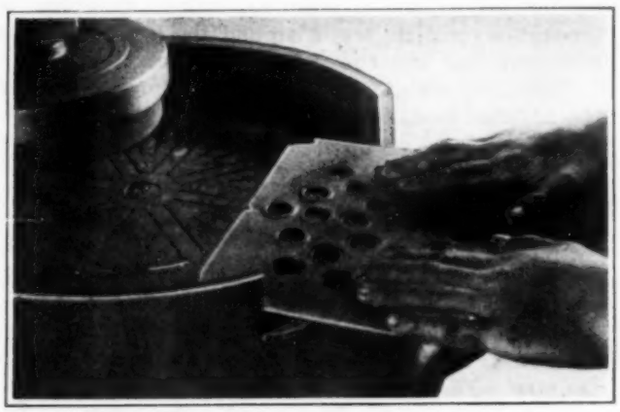
Handling Thin Work on a Magnetic Chuck

By Milton Wright

The illustration shows a quick and easy method of loading a magnetic chuck with thin pieces that are neither easily placed nor securely held without the locating plate. The parts are ball races for small thrust bearings.

The operator is provided with two steel plates of a size that will cover the chuck, yet not so large but that they will swing without having the corners interfere with stationary parts of the machine. The thickness of the plates must be slightly less than that of the pieces to be ground. Each plate is bored with a number of holes, spaced as closely as may be convenient, the diameter of which is such that the work-pieces will drop loosely into them.

Two other plates of the same size, but which may be of thicker material, have no holes in them and one edge of each is concaved to a radius corresponding to the periphery of the magnetic chuck. The reason for two sets of plates is that an assistant may be loading one set at the bench while the operator has the other on



Loading thin work on a magnetic chuck

the machine and is thus enabled to keep the latter in practically continuous operation.

With a bored plate lying upon a plain one on the loading bench, the loader fills the holes with the work-pieces. The machine operator picks up the pair of plates, sets the concaved edge of the lower plate against the periphery of the chuck, and slides the upper plate and work on to the magnetic surface.

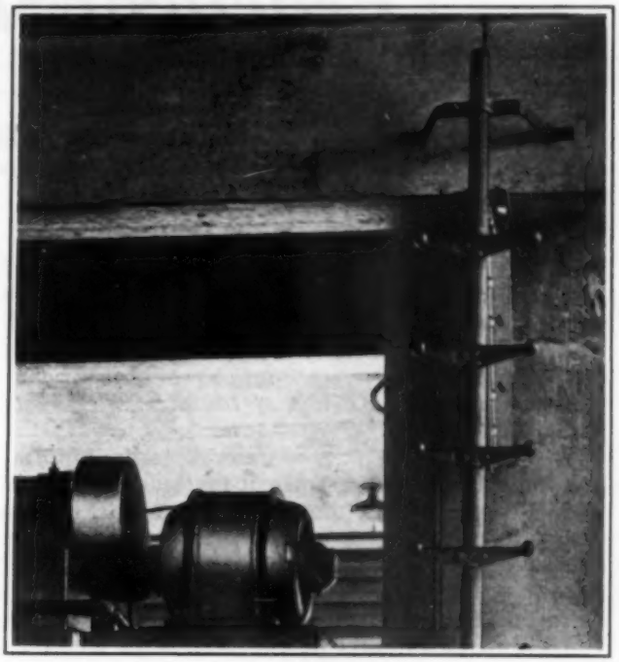
After the grinding has been completed, he removes the finished work by reversing the process, and hands the plates to the loader to be dumped and reloaded, at the same time receiving from him the newly-loaded pair.

An Inexpensive Ladder

By W. Edward

At the plant of the Edward G. Budd Co., Philadelphia, a number of ladders were needed to give access to the overhead cranes. They were built and installed as shown in the illustration.

A piece of 2½-in. pipe forms the upright and the



The ladder in position

rungs are of cast iron. The rungs are approximately 12 in. long; have balls on the ends, corrugated treads about 1½ in. wide, and semicircular recesses to fit the pipe, to which they are held by U-bolts.

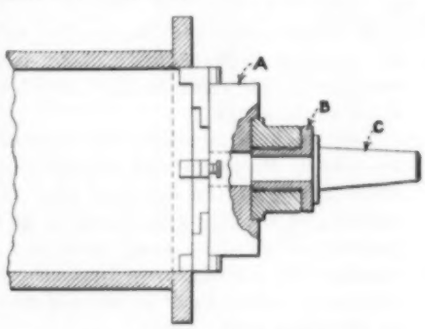
The whole assembly is secured in an upright position by strap-iron brackets attached to the overhead girders, and forms a stiff, inexpensive and neat arrangement.

Substitute for a Pipe Center

By Ervin W. Tate

Having to face the flanges on several pieces of 12-in. cast-iron pipe, and since we had no pipe centers large enough for the job, we proceeded as follows:

One end was chucked by the inside in the usual manner, while the tailstock end was held as shown in the sketch. The 10-in. chuck *A* was mounted on the adapter bushing *B*, the whole being assembled on the center plug *C* so as to revolve. The center plug was held in the tailstock spindler. The pipe was gripped on the inside by setting out the chuck jaws.



Improvised center for pipe

Gripping both ends of the pipe on the inside, allowed both flanges to be faced at the same setting, since it was essential that the faces of the flanges should be parallel.

Practical Shop Problems

Questions of a Practical Nature will be answered in these columns

Drill-Press Slide Design

Q. We are designing a multiple-spindle drill which contains a slide for guiding 10 drill spindles, set in a line on approximate 1¾-in. centers. We are limited in the height we can allow so a question has come up with reference to the correct relation between height or length of guides and width of the slide. Please let us have your advice.

A. In general, it is good practice to limit width to not more than length keeping it preferably in the ratio of 4 to 5 or even better 2 to 3. However, there are many instances where this cannot be done and sometimes the width is necessarily even greater than the length.

In such cases, short of extremes, the member will work without difficulty unless there is an unusual off-center load that will set up a tipping and corresponding wedge action. As width increases over height the side-thrust pressures approach concentration in an upper corner and in a diagonally-opposite lower corner. This condition is accentuated by any looseness in the guides and increases in intensity as the width increases to the point where a toggle condition may be present. Under such a condition, lubrication cannot be maintained between the ways and the slide at the corners in contact.

If, in your case, the slide is to be moved and set while the spindles slide in it the ratio is not so important. If the slide furnishes the spindle advance and if there is to be an off-center pressure, then the ratio is important as well as the area of bearing for side thrust and the means for taking up wear.

Rotating Speed of the Agitator in a Mixing Machine

Q. Please give use the correct solution of a problem in rotation with regard to the agitator of a mixing machine in its relation to a point at the center of the main drive shaft.

The machine consists of a central driving shaft with an arm at its lower end in which the vertical agitator shaft carrying the agitator fork is mounted. On the upper end of this shaft, which is free to turn on its bearing in the drive-shaft arm, is a pinion. The pinion meshes wih a stationary internal gear which causes the pinion to rotate as it is carried around by the rotation of the main drive shaft.

The main shaft turns at 40 r.p.m. The ratio between the pinion and the stationary internal gear is 1 to 4. What is the speed of the agitator shaft with regard to the center stationary point on the main drive shaft?

A. This problem is a confusing one unless it is approached a step at a time, but is then, in reality, quite simple once it is correctly viewed.

The rotations made by the pinion with respect to its own shaft will be the same when it is moved around the center of the stationary gear as if its center were stationary and the gear rotated. For 40 r.p.m. of the pinion about the center of the gear, then, it will rotate at 40 times the gear ratio, 4, or 160 r.p.m. This rotation must then be translated to have reference to the center of the main drive shaft.

Assume the pinion in a given position, and then consider its being moved 90 deg. through its circular path. It will itself have rotated one-quarter of a total circle multiplied by the ratio or once completely around. The point of contact between gear and pinion with reference to the center of the gear has moved 90 deg., however, in a direction opposite to the pinion rotation. Therefore, with respect to the gear center, the pinion has lost one-quarter of a full revolution. Carrying this through a complete travel around the gear, the pinion will have lost one complete revolution.

Therefore, with the drive shaft rotating at 40 r.p.m., the agitator shaft will rotate at $40 \times 4 - 40$, or 120 r.p.m. about the center of the main drive shaft.

Effect of Lubricant Suddenly Applied to High-Speed Drills

Q. We have a drilling operation that has to be done horizontally. The work is a combination of ⅛ in. of mild steel, 1½ in. of malleable iron, and a final ⅛ in. of the steel. The hole is ⅜ in. in diameter. It is difficult to get lubrication to the high-speed drills, which we have used for the work, on account of the plane of drilling, so that even though we flood the drill to cool it as it emerges through the hole, and again before we start the next one, we have a very high drill breakage. What do you suggest to correct the trouble? The drills are fed by hand.

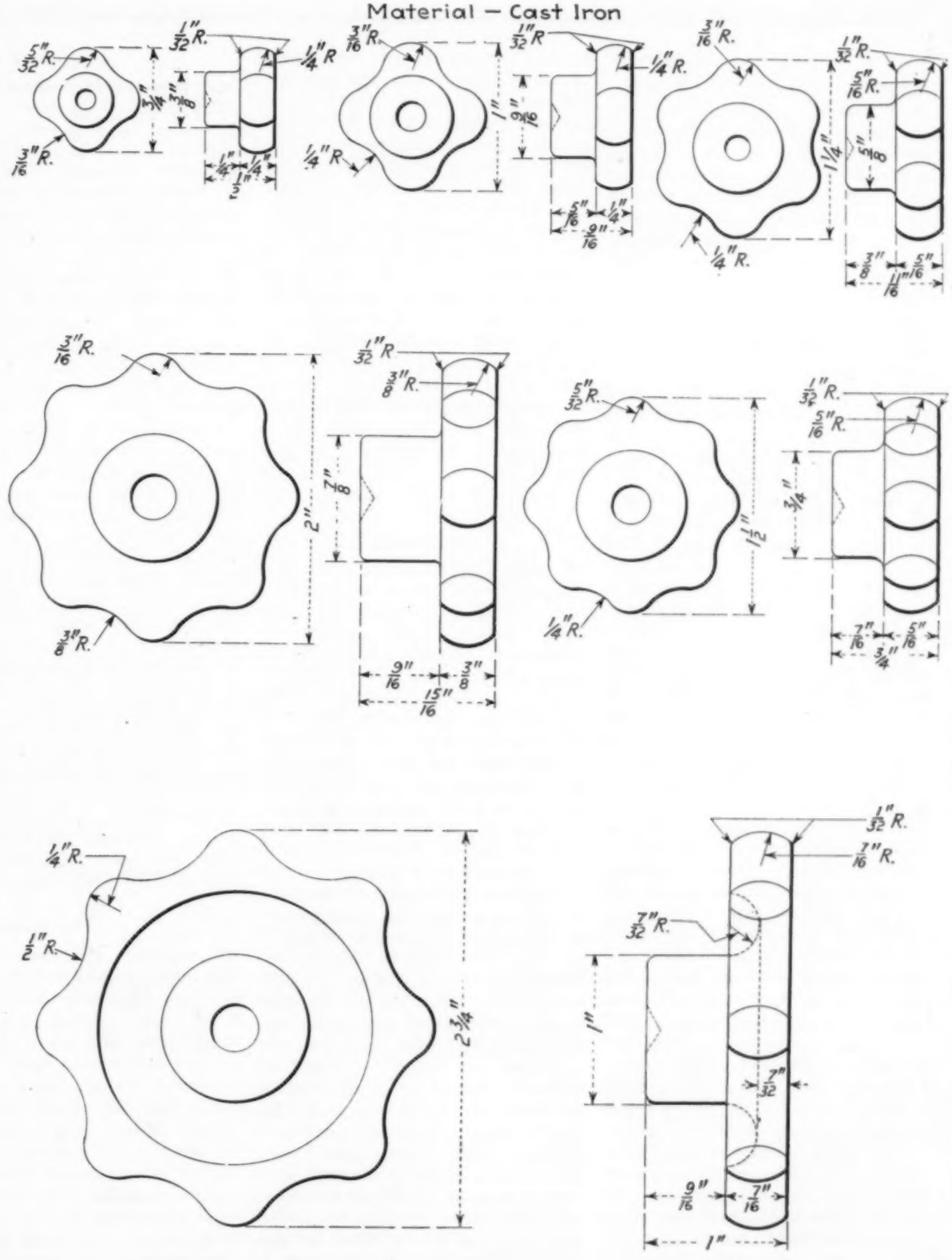
A. The very probable reason for the high breakage is the direct result of suddenly cooling the high-speed drills, as they come through the work, and of starting them cold into the next piece. Cooling a hot high-speed drill is practically certain to cause the steel to check and break as soon as it is again put to work, if not before. Putting a full load on a cold high-speed drill before it has had a chance to warm up is almost as bad practice.

If you cannot keep the drills flooded it will be far better to drive them dry. Even when they are extremely hot they are still in condition to do good work.

It would be a good plan to also instruct the workmen, if you have not already done so, to pull the drill out at least twice during the operation, to clear it of chips which will otherwise tend to clog the point and prevent free cutting. A clogged point results in a dragging action that is detrimental.

Hand Knobs for Jigs and Fixtures

Material — Cast Iron



Punch here to suit your binder

Trim Line

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Technical Abstracts

Foreman Training

G. L. Gardiner, director of foremanship training, Oakland Motor Car Co., gives a brief article in which he states that the majority of foremen in industry today are functioning incompletely simply because managers have not thought to provide their foreman with sufficient facts about the business. Management has not been careful to impress upon its foremen the fact that modern industry is looking for leaders not drivers. We are now satisfied that men can be led further than they can be driven.

A foremanship training program must be practical in its application. The material presented to foremen must be concise and in such form as to be easily assimilated. It must be borne in mind that the average foreman is not a student. He is an extremely practical man who has usually been educated in the school of industrial experience. He has a supreme contempt for "experts." The conductor of a foremanship training program must not pose as an "authority." He must act as a steering committee to keep the training program on an even keel. If we can set high ideals and standards for the practice of foremanship, we will soon raise the quality of foremen. The training of foremen is management's responsibility and is the next big job.—*American Management Review*, Oct., 1925, p. 305.

Compensation Acts

Compensation acts developed in Europe, with the United States following its lead. Germany took the initiative principally on account of her industrialism and her highly developed trade unions fostered by the government. Other European states immediately followed Germany's lead. The benefits under these acts are similar in form to those we have today in the United States. The basic principle underlying the theory of workmen's compensation laws is that an employee who sustains an injury arising out of the course of his employment should be indemnified for loss of earnings without regard to fault. In other words, the employer is held responsible for the damage, and the cost of such indemnification comes out of the running expenses of the concern. There are two exceptions, however, if it is proved that a man willfully injures himself, or that he was intoxicated at the time of the injury, he has no recourse under the law to recover from his employer. Nearly everyone today agrees that the principle of this law is just, humane and economically sound, and so far the best means for solving that perplexing legal relation of master and servant as it affects the servant in case of occupational accident.—*Bulletin of the Taylor Society*. Oct., 1925, p. 226.

Selecting Equipment

It has been estimated that the total value of the machine tool equipment in automotive plants, not considering jigs, fixtures, small tools, or woodworking machinery is $560,000,000, and that for every automobile built, machine tools to the value of over $25 are actually used up in its construction, or, in other words, each car built depreciates the value of the equipment over $25 on an average. It is no wonder then that the equipment engineer finds it necessary to use extreme care in selecting machine tools.

In selecting equipment the production required each day must first be definitely determined because both the methods of machining and the type of machines selected depend primarily on this factor. If the production is high the equipment engineer is immediately confronted with the problem "Shall I buy special or standard machine tools?" Further with high production the effect of breakdowns becomes a factor of primary importance. Other factors enter into the problem, such as the quality of the work, the quantity required, the unit cost of the work, the cost of maintenance and the ease of operation.—*Machinery*, Oct., 1925, p. 87.

Worm Gearing

The F. J. type of worm gearing used in all models of Timken Worm Drive axles for trucks, buses and cars is a special one. The worms are forged from chrome-nickel steel in the Timken-Detroit Axle Co.'s own forge shop. They are then normalized; that is, given a preliminary heat-treatment to make the machining operations easier, and relieving the strains.

The normalized worms are then cut to length and centered; straightened under a press, rough turned, then finish turned. The worms are then ready to be thread cut. This is done on a battery of special worm-thread milling machines in which they are first roughed out to a tolerance of 0.001 in. per in. of lead. The distance from tooth to tooth is held to a maximum variation of 0.002 in.

After they are rough-milled the worms are then carbonized and hardened to give a Scleroscope reading of 85 to 90, after which the ends are drawn to make them soft enough for machining. Finally the grinding of the worm thread is done in another battery of special machines. In this grinding operation a limit of a half thousandth per in. of lead is maintained. The spacing from tooth to tooth is held to .001 in. Precision gages are used to check each detail of worm threads, and the bearing diameters are ground to size as well as the taper end for the universal joint flange. The threads are then milled, cotter pin holes drilled and keyway cut. The worm is rolled with a master gear to insure perfect interchangeability with similar worms.

After the preliminary machine operations of boring and facing the worm wheel, the teeth are cut on a special battery of hob machines, the hobs being accurately made by the Timken - Detroit Axle Co. itself. After the teeth are cut, the finished worm gear, is matched with a master worm to insure interchangeability. —*Timken Magazine*, Sept., 1925, p. 528.

American Machinist

Established 1877

KENNETH H. CONDIT AND FRED H. COLVIN, *Editors*

Two Thoughts for Trade Associations

SPEAKERS at the meeting of the Academy of Political Science voiced two thoughts worth pondering by members and officials of trade associations. The first one is that, linked with the present favor in which the trade associations find themselves, there is an added responsibility that they confine their activities strictly to the legitimate ones stated by the United States Supreme Court in two important decisions. If they overstep the bounds and thus forfeit public confidence their lot will be far harder than in the darkest days before 1923.

The other thought has to do with association activity in terms of depression. It was stated that during such periods the European trade associations dig in twice as hard and endeavor through technical research and market investigation to stimulate the sales of the products of their members. American associations, on the contrary, are apt to discontinue such activities as being dispensable and not immediately revenue producing. In other words, they are guilty of the same vital mistake made by many American companies of dropping their personnel and research work when times are hard—just when they can do the most good.

Better Addresses

POSTMASTERS in big cities all over the country are up against the problem of careless and incomplete addressing of mail. A recent appeal from the New York City postmaster, whose troubles are worse than those of any other postmaster simply because New York is bigger than any other city, should be heeded. He asks that the regular way of addressing mail to street and number be followed universally instead of giving the names of two intersecting streets or the name of an office building.

When the regular carrier is on the job there is not so much trouble because he has memorized the names and addresses of the companies and individuals on his route. But when he is sick or away and a substitute is working, the case is very different. Just recall some of your own experiences in trying to locate men in strange cities where the only address you had was the name of an office building and you will see why some of your mail is delayed.

The convenience of having both street and avenue on your letter head is a real one to the visitor but it may be quite the contrary for the sorter of mail in a districted city where the division is by street numbers. Why not put your full address on the letter head—500 Blank Ave. at 100th St.? Then every one would be taken care of.

Eight Hundred New Machines to Replace Old Equipment

MORE than two years ago several engineers and builders of machine equipment felt that they foresaw changes in the automotive industry that would materially lessen the number of automobile building concerns. They also predicted that the firms that survived would be obliged to re-equip their plants so as to meet competition by reducing manufacturing costs.

Both of these predictions are working out, though perhaps not as rapidly as was anticipated. Several builders of automobiles have dropped out and practically all of those who expect, or even hope to stay in the game, are buying new equipment.

One large concern is installing over 800 new machines in its plant in order to secure maximum production at minimum cost. While this is perhaps the greatest single installation of replacement equipment, it is typical of the trend of the industry. A hearty co-operation between such large users and the builders of cost reducing machines cannot fail to benefit both.

Just Suppose

JUST suppose, when you had a difficult piece of machinery to design up in the drafting room, that it was the custom of the chief to have you sketch your idea and take it out to John, in the pattern shop, and Bill, in the foundry, and Pat, over in the machine shop, to get their slant on the thing they were going to have to make as soon as you had finished.

By chance, John might show you how to fix the thing so his core boxes would be quite simple, and Bill could, perhaps, give you a tip on getting certain sections uniform to hold his losses to a minimum, and Pat might even suggest a little kink to help out his finishing operations on the equipment he had available.

Of course, though, John and Pat and Bill must not be allowed to run the designing department, for their place is in the shop, and perhaps you can manage to worry along without showing the fact that you are a bit lame on that kind of design, but—

Just suppose.

Shop Equipment News

Wilmarth & Morman "Super" Surface Grinder, No. 78

The Wilmarth & Morman Co., Grand Rapids, Mich., has revised the design of its No. 78 surface grinder, previously described on page 41, Vol. 54 of the *American Machinist*, and has developed its No. 78 "Super" surface grinder.

Ready access to the various

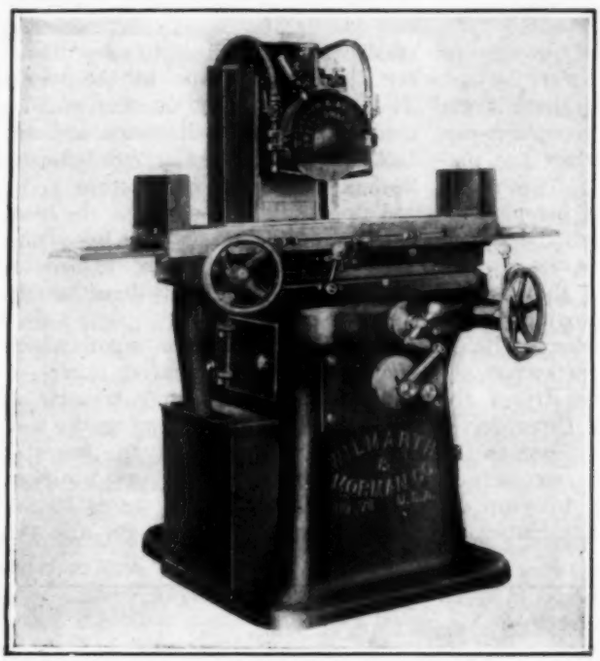


Fig. 1—Wilmarth & Morman "Super" Surface Grinder, No. 78

mechanisms, drive mounted on ball bearings, a flexible coupling from the motor, a ball bearing clutch, ball and roller bearings in place of bronze, a patented spindle with positive take-up, and direct flow of coolant from the saddle to the coolant tank are features of the machine illustrated.

As in the original machine, the controls have been located for the convenience of the operator. The elevating handwheel is geared to its drive so the divisions on its dial are ⅛ in. apart, but register 0.0005 in. between divisions. This wheel is located to the right while the longitudinal table-feed handwheel is at the left-hand side. There is a graduated cross-feed ball-crank handle, an automatic cross-feed throw-out lever, with adustable dogs to set for a desired width of grind, and a longitudinal table-starting and stopping lever for use in automatically transferring the table feed from power to hand operation. Clutches are used in this last named control .so change is positive from one feed drive to the other. Feed, at one or both ends of the stroke, can be selected by turning a knurled knob near the center of the machine.

The spindle rides in deep-groove type ball bearings and is arranged to take up lost motion automatically. A hand-adjustable take-up is also included. All of the bearings are protected against the entrance of dust and grit.

The hardened steel clutch, for use in reversing the table travel, is mounted on ball bearings on a hardened shaft, the balls acting as a driving key between shaft and clutch. This arrangement has been made to result in free action of the clutch and to eliminate jar at the point of table-travel reverse. The clutch is guaranteed not to slip prematurely or to stop on center.

The grinding wheelhead travels vertically on flat ways located on the front and rear of the upright housing and between tapered ways within the housing. A take-up is provided at the rear of the wheelhead and is designed for sensitive manipulation. There are two head-elevating screws with right- and left-hand Acme threads arranged to work in unison. They are mounted in adjustable

Fig. 2—The operating mechanisms and the access doors

bronze nuts which serve to compensate for lost motion in the elevating mechanism.

The table is mounted on two ways, one flat and one tapered, and is driven by means of a spiral rack and pinion. There is ample spread between the ways to insure steadiness in the arrangement.

In the saddle mechanisms and controls, simplicity has been featured. Large openings have been provided in this part of the machine to allow for free flow of the coolant from the saddle to the coolant tank. Sliding, telescoping dust guards protect the parts.

The main frame is a one-piece casting proportioned for stiffness and stability. This frame is pro-

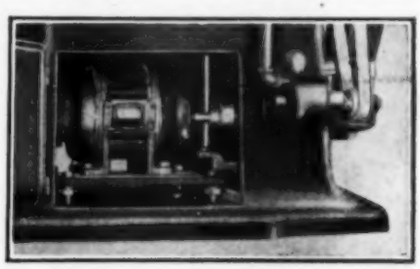


Fig. 3—The motor mounted in the base compartment

SHOP EQUIPMENT NEWS

vided with openings, Fig. 2, to permit of access to all of the mechanisms within, that include the gear box, the worm-feed gear and the automatic mechanism. The arrangement makes it unnecessary to lift the saddle or the table to get at these parts. The gear box contains the reversing gears that are driven by the ball-bearing clutch already described.

As shown in Fig. 3, the machine can be arranged to be driven by a motor located inside the base. A 1½-hp., 1,200-r.p.m. motor is recommended for this service, and, when furnished by the purchaser, must be sent to the company for assembly before shipment of the grinder.

A door, on each side of the base, makes the motor fully accessible and simplifies the problem of caring for it properly. The motor compartment is separated from the upper chamber containing the driving mechanism, connection from motor to drive being supplied through a ball-bearing drive shaft and a flexible coupling.

The machine is regularly furnished for wet grinding, the coolant being piped to both sides of the wheel to insure complete flooding of the work as it enters and leaves the wheel. The pump and piping are built into the machine. The coolant tank is located conveniently at one side.

The machine occupies a floor space of 44x86 in. and weighs 2,300 lb. net.

"Omco" Internal Grinding Machine 12x10-Inch

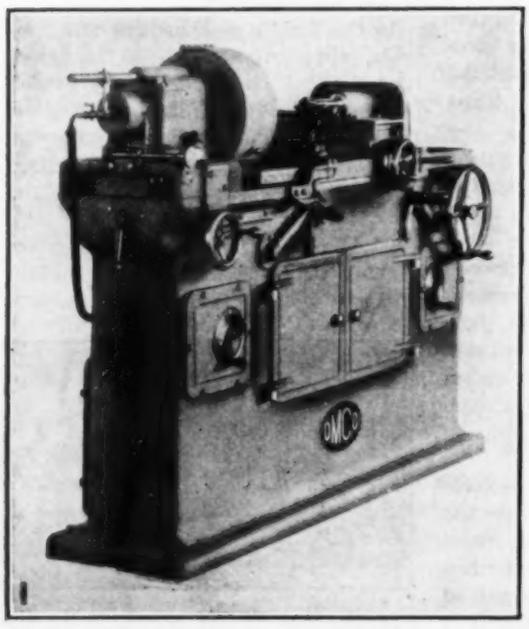
The Oakmont Manufacturing Co., Upper Darby, Philadelphia, Pa. announces the "Omco" internal grinding machine for the market. It is intended for production grinding on internal surfaces that range between ⅜ and 12 in. in diameter and in length up to 10 in. The construction of the machine is such that internal shoulder grinding can be done to high limits of accuracy and actuating mechanisms have been designed to result in simplicity of operation and compactness.

The bed is of the ribbed-box type and, by inclosing all of the driving units and operating mechanisms, affords protection for them from grit and moisture. All openings can be completely closed when the machine is in operation. The units, thus protected, include independent drives for the workhead, the wheelhead and the wheel traverse. The workhead drive and the wheel-traverse drive are provided with variable-speed, d.c. motors with a speed range of 600 to 1,800 r.p.m. A 3,600-r.p.m., a.c. motor drives the wheelhead spindle. All three drives are through belts. The motors are suspended on hinged connections and are provided with take up devices which act to automatically compensate for belt stretch and serve to maintain a constant belt tension.

The workhead is of rigid construction and carries its spindle in two bearings which measure 2¾ in. in the smallest diameter by 4 in. and 3½ in. in length respectively. The spindle is of the double-taper type and is designed, with its bearings, so adjustment for wear can be readily made. This adjustment is positive in its action. A hole through the spindle measures 1⅝ in. in diameter and admits of using a collet tube for small work as well as to allow room for the coolant pipe to the work. The driving pulley on the spindle measures 5 in. in diameter and rotates through a speed range between 20 and 180 r.p.m., in 26 stops.

For grinding taper work, the head can be swiveled on its base and rigidly clamped in any horizontal position and in either direction up to 15 deg. off center.

The wheel carriage, upon which the wheelhead is mounted, is also of rigid construction and travels on protected flat and V-ways on the bed. In fact, no portion of the ways is exposed in any carriage position. The length of these ways is 35 in., measured on the carriage, and the



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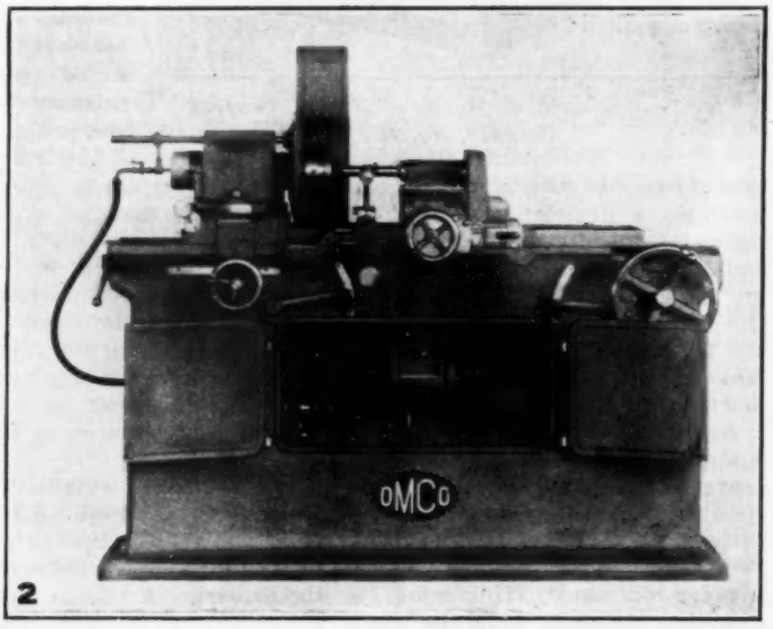

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Fig. 1—"Omco" Internal Grinding Machine, 12x10-Inch. *Fig. 2—Front view with the access doors open*

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spread between ways is 10½ in. The carriage travel is 10 in. maximum.

The wheelhead, itself, is built in a combination of bronze and ball-bearing design and is constructed so it can be adjusted for any wear on the bronze bearing while it is running. Takeup of the ball bearings is automatic. The construction of the spindle, with a small neck connecting that portion on which the driving pulley is mounted to the wheel-carrying section, results in the former absorbing all of the shock and vibration from the belt without transferring anything but rotary movement to the wheel. This point is a particularly important one when the high rotative speeds necessary for correct wheel speeds on small work are considered.

The wheelhead is mounted on the upper of two carriage cross-slides. This slide provides the cross feed and is purposely limited to a short movement to prevent the use of too small a wheel for a given job. The lower slide is provided to allow a quick backward motion when setting the machine for taper or step work.

Feed to the work can be operated by means of a handwheel or automatically at each end of the carriage travel, or straight in, automatically, when it is desired that the carriage remain stationary on its ways.

The main graduations on the feed dial, for 0.001 in. in the work diameter, are approximately ⅞ in. apart. These graduations are subdivided into five parts which show 0.0002 in. in the work diameter. The automatic feed can be varied, at will, from the maximum to zero in steps equal to these small subdivisions.

The wheel-drive motor is hinged from the carriage as can be seen through the open doorway in Fig. 2 and travels with the carriage. While it is hinged, as stated, to allow swing in a vertical direction, it is rigid with respect to the carriage laterally.

The drive, to traverse the carriage, is through a screw with right- and left-hand threads, two nuts, one right-hand and one left-hand, and a pair of clutches. The drive can be engaged or disengaged from the operator's position and positively shifted from hand operation to power drive, or vice versa. Changes of speed on the variable-speed motor are made by a rheostat control.

The design of this drive has a number of points which result directly in the ability of the machine to do work of fine limits of accuracy and to be dependable for use in shoulder grinding where failure to stop on point and reverse would be disastrous.

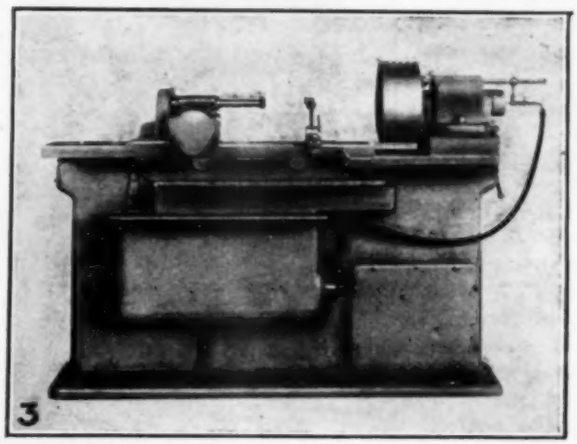
The driving screw is mounted within the base of the machine at the exact center of gravity of the carriage, head, and driving assembly which is built as a unit.

The carriage is stopped at a point directly in line vertically and horizontally and directly ahead of the center of gravity of the assembly.

The construction of the screw drive is such that no rotating part changes direction when the carriage travel is reversed and therefore no back lash or possible wear can have an effect on the limits as set by the reversing stops.

Finally, the principle of stop and reversal is made to depend on the carriage striking an obstruction to cause shift in the reversing mechanism. Thus, if a tool is accidentally laid where the carriage will strike it and jam, should it go any further, or if an obstruction should occur to hinder progress at the wheel, further motion will instantly stop and the travel will be automatically reversed. If the obstruction is removed the original set limits will act but if it is not it will act itself as a new stop.

This last point serves to keep repair costs down as well as to be of benefit to operation when grinding blind holes or doing shoulder work. Positive reversal is guaranteed within a limit of 0.0005 in. regardless of any change in traverse speeds, of which there are 13 ranging from 20 to 60 in. per minute.



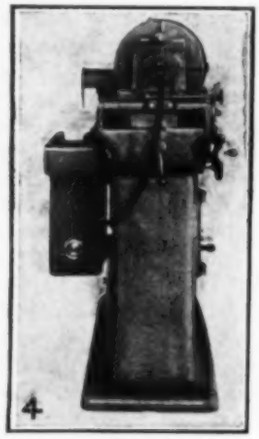


Fig. 3—A rear view. Fig. 4—An end view from the workhead end

The stops themselves are graduated to 0.001 in. and can be altered readily at either end of the stroke to compensate for side wear of the wheel.

Lubrication of the ways is taken care of by pockets and rollers. The heads are oiled from wells and the tapering of the spindles, increasing in diameter from the center to the ends, acts as a positive pump to carry the oil along. This feature also serves effectively to preclude the entrance of water or grit from the outside. Lubrication of the high-speed workspindle is required but twice each day.

The controls are all at the front of the machine within convenient reach of the operator as shown in Fig. 2. The head can be moved on its ways by means of the handwheel and rack to the left. The workhead speed control is shown just below this handwheel. The head is stopped and started by manipulating the lever to the left above the center doors while the traverse power-drive control centers in the similar lever to the right. The large handwheel to the right is used to operate the traverse by hand. The lever below this handwheel controls the rheostat for the traverse-drive motor. On the carriage the handwheel operates the feed by hand while the small quadrant to its right sets the amount of feed.

The rear of the machine is shown

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in Fig. 3. The two plates in the lower corners serve as mountings for the variable-speed motors. After removing the bolts, these plates can be swung out to bring the motors into position for inspection.

The coolant tank and the pump are built as a unit and are also mounted at the rear. This unit has three settling compartments through which the water must pass before reaching the pump. The pump is of the centrifugal type and is driven from the workhead countershaft. This arrangement causes the pump to stop when the drive is cut off from the head.

The revolving parts are tested to insure dynamic as well as static balance before being assembled. The machine occupies floor space of 78x29 in. and weighs 2,400 pounds.

"American" Electric Rivet Heaters

Two styles of the line of electric rivet heaters, being built by the American Hoist & Derrick Co., St. Paul, Minn., are illustrated. The line is intended for rivet-heating work in boiler and tank shops, car and ship-building plants, structural shops and wherever heated rivets are used.

In Fig. 1 is shown a style known as model "B" that has beeen designed particularly for use on structural work. It is arranged to heat four rivets simultaneously. There are three contact elements. The center set is stationary and is used on both

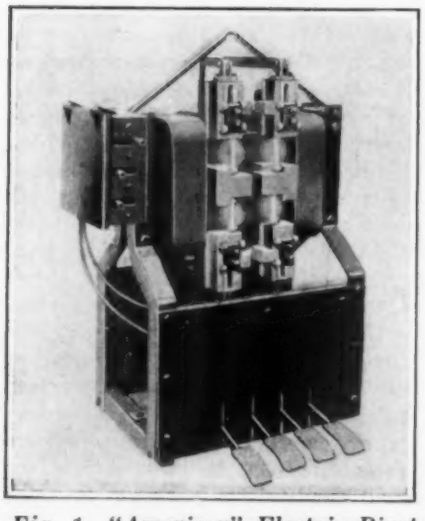


Fig. 1—"American" Electric Rivet Heater, Model "B"

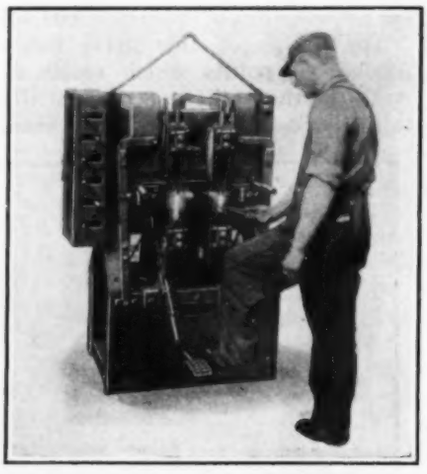


Fig. 2—The model "C" heater

top and bottom, while an upper and a lower set are arranged to slide up and down and are actuated from foot pedals at the front. The stroke and setting of the sliding contacts, in this heater, permit of heating rivets up to and including 9 in. in length.

At the side of the heater, a control box incloses contact switches that are interlocked and arranged to regulate the current for varying heating speeds and rivet sizes. There is a larger size, built on the same general lines, that will accommodate six rivets, and a smaller, portable machine for heating two at one time. When so desired, the larger sizes can also be furnished in the portable form. Sizes suitable for heating any rivet are available in the line.

In Fig. 2 is shown a style known as model "C" that is intended for use in boiler shops. In this machine there is provision for heating two rivets simultaneously between adjustable jaws. The lower jaws are set at a desired point for the work in hand. The upper jaws are slid on ways by means of treadles to which they are attached.

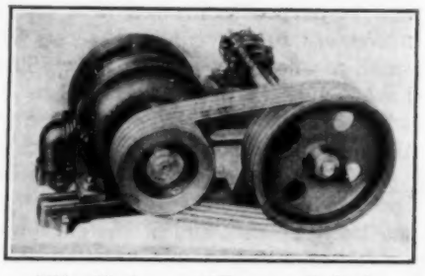
In addition to these main jaws and a heat-control unit similar to that in the model "B" machine there are auxiliary side contacts that can be used to pass a local current through a given section of the rivet to heat this section faster than the rest. The grip of a boiler rivet can thus be made softer, when it is so desired, than the part which is to be formed into the head.

The sliding jaws are of solid cast copper. They are provided with a step arrangement on which the rivets make contact. The construction of the laminated core is such that both of the legs are used and make the double-deck design possible in the model "B" heaters. The primary coils are wound with asbestos-covered wire. The frame is constructed of angle iron. The model "B" weighs 1,900 lb. The model "C" weighs approximately 2,300 pounds.

Allis-Chalmers "Texrope" Drive

A short-center flexible drive known as the "Texrope" drive has been developed and placed on the market by the Allis-Chalmers Manufacturing Co., Milwaukee, Wisconsin.

The drive, as illustrated, consists of two grooved sheaves and a number of specially constructed, endless V-belts. The belts just fit the sheaves and it is said that there is



Allis-Chalmers "Texrope" Drive

no slack or lost motion in the drive. Their "V" construction tends to make them grip the grooves more firmly as the pull is increased. They are elastic and thereby reduce the vibration and jerking in the transmission.

Drives of this design, varying from ½ to 250 hp. and with ratios up to 7 to 1, have been placed in service.

Hoxite Welding Flux

A flux for oxy-acetylene welding has been placed on the market by the Hoxite Co., 62 Summer St., Stamford, Conn.

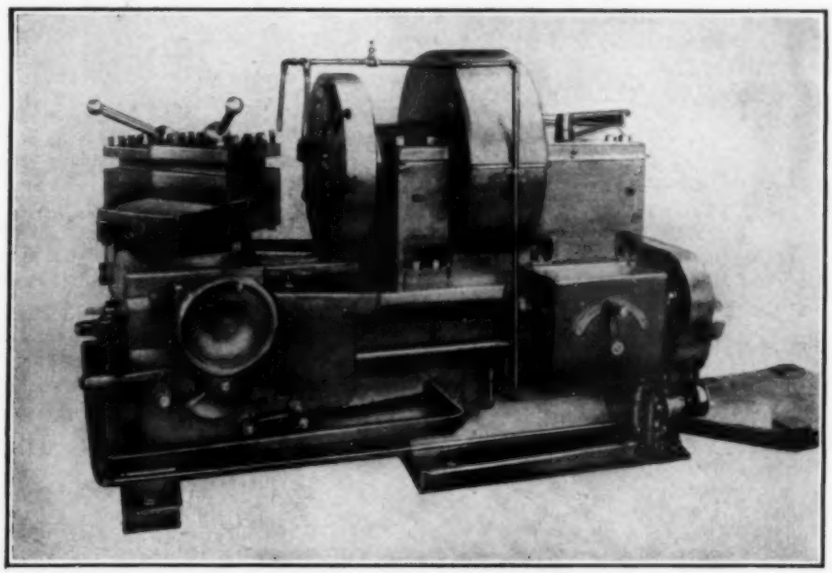
Tests, which have been conducted with the flux, are said to show efficient results on cast iron, malleable iron, aluminum, government bronze, Monel metal, brass, semi-steel and other metals.

Some of the characteristics claimed for the flux are that it will not blow off the welding rod, that there is no frothing, and that it gives off no disagreeable fumes.

SHOP EQUIPMENT NEWS

Betts-Bridgeford Heavy-Duty Gear-Turning Lathe

The gear-turning lathe, illustrated, is a special-purpose machine that has been put on the market by the Betts Works of the Consolidated Machine Tool Corporation of America, Rochester, N. Y. It is intended particularly for turning the face and back angles of heavy, alloy-steel bevel gears.



Betts-Bridgeford Heavy-Duty Gear-Turning Lathe

The lathe follows the general design worked out by the company for similar equipment but has been built heavier and has a number of improvements included in its arrangement.

The bed is approximately 6 ft. in length and is built as a box-section to carry broad flat ways on which the carriage is mounted. The carriage carries two independent cross slides that can be clamped to the bed. Each of these slides supports a heavy, swivel, tool slide that has a revolving four-way steel turret toolpost mounted upon it. The tool slides, with their square guides are designed for particularly heavy duty. Each slide has its independent feed drive, there being two drives, one on each side of the machine each providing four feeds.

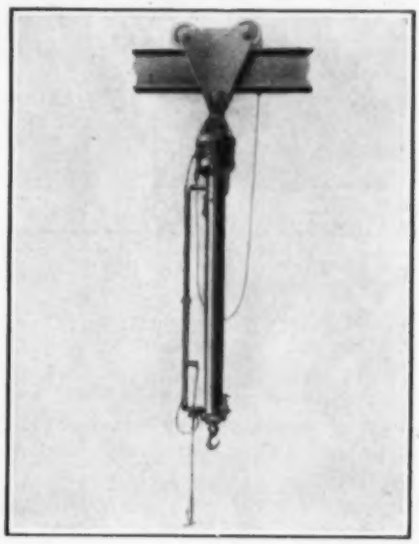
The aprons are double-wall, one-piece castings and are arranged to carry positive feed-trip mechanisms. This feed trip is disengaged instantly when a slight pressure is exerted on the trip lever.

The machine is driven by a 25- to 35-hp., adjustable-speed motor for which a floor plate mounting is arranged at the end of the machine. The motor is geared to the drive shaft. The variable-speed drive with the two speed changes in the machine provides an ample range for the work. As illustrated, a chuck is mounted on the spindle to carry the gear blanks but an adapter can be used instead if it is preferred. With the double arrangement of tool slides, the face and back angles can be machined simultaneously.

The machine illustrated has a swing of 31 in. over the bed and 22 in. over the carriage. The tool slides are arranged to be moved 8½ in., maximum, in any direction horizontally.

"American" Electric Oil Hoist

The electric oil hoist has been put on the market by the American Hoist & Derrick Co., St. Paul, Minn. As illustrated, it consists of a cylinder and piston, the latter terminating in a load hook, together with an electric motor and an oil pump mounted at the top of the cylinder. There is a system of piping and operating valves between the pump and the cylinder and a truck arrangement for suspending the equipment from an overhead track. The hoist



"American" Electric Oil Hoist

is intended for general application.

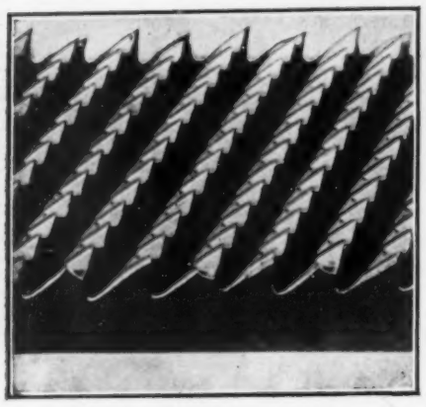
The motor is snap-switch controlled, and, when started, will pump oil, with which the cylinder is filled, from above to below the piston, thus raising the load hook. A valve in the line can then be operated to allow the oil to flow back from below to above the piston, the latter, thus released, descending by gravity. The load can be raised any distance up to the limit of the travel of the piston or lowered to any desired point.

Service Tool Corporation "Shearkleen" File

The Service Tool Corporation, Latrobe, Pa., has developed and is marketing the "Shearkleen" double-cut file. A close-up of the teeth of this file is shown to illustrate their form, designed as the result of study of the cutting factors of teeth in milling cutters and lathe tools and application of the principles to file problems.

The positive rake or undercut on the front of the teeth produces a true cutting effect and avoids any tendency to scrape the surface. The space between the teeth is cut deep in order to impart self-cleaning qualities to the file when used on hard or soft metals and to adapt it

SHOP EQUIPMENT NEWS



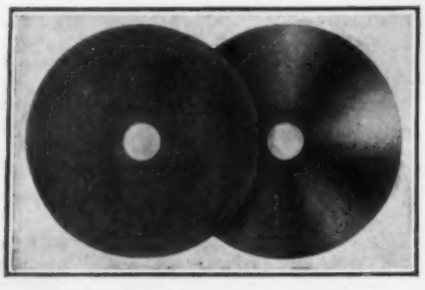
Service Tool Corporation "Shearkleen" File

to use on wood and non-metallic materials.

The teeth are milled from solid alloy-steel stock to give a sharp cutting edge with a true form. It is said that the sandblast process can be used several times to restore the sharpness of the teeth after they are worn.

Perks Grinding-Wheel Safety Washer

Safety washers for grinding wheels are being marketed by Geo. W. Perks & Co., Akron, Ohio. A method of vulcanizing rubber to metal is utilized in the construction so that the steel washers can present a rubber surface next to the



Perks Grinding-Wheel Safety Washer

grinding wheel. When clamping pressure is applied the rubber is forced into the porous surfaces of the wheel, providing additional security and protection against too much clamping strain.

The rubber used on the washers has a tensile strength of 4,000 lb. and is of a thickness only sufficient to imbed itself into the porous surface of the wheel so that the centrifugal force is transferred through the medium of the rubber to the wheel.

A test grinding wheel, 14½x1½ in., broken in two pieces, is said to have held intact after a continuous run for five hours at 2,250 r.p.m. Experiments of a similar nature have been conducted by the Carborundum Co. and others that have demonstrated the usefulness of the safety washers on grinding wheels.

It is recommended that the flanges and washers which are made in all sizes, be not less than 60 per cent of the diameter of the wheel.

Trent Electrical Melting Pots

A line of electrically-heated melting pots are being marketed by Harold E. Trent, 259 North Lawrence St., Philadelphia, Pa. The pots are intended for melting babbitt, type metal, solder, lead, tin, needle metal and other materials

Fig. 1—Trent Electrical Melting Pot

of approximately similar melting points. They are being made in four standard sizes for capacities of from 10 to 1,500 pounds.

The heat is furnished from the electric circuits in the shop and can be controlled by hand or by means of a thermostat. The heat can be applied rapidly and can be maintained at a desired point. The crucibles are made of fine-grain cast iron, are designed with an integral flange and proportioned to counteract stresses due to temperature changes.

The casing is of sheet metal with an aluminum paint finish. The casing is insulated on the inside to act as a refractory as well as to guard against heat losses. The heating elements are of the Chromalax embedded type and are positioned so they will act effectively.

In Fig. 1 is shown a pot with a 12 in. crucible having a capacity for 180 lb. of lead. The overall dimen-

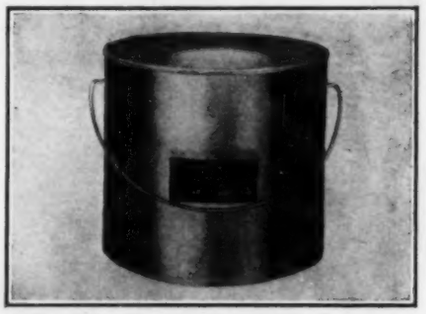


Fig. 2—One of the smaller sizes

sions are 21 in. across by 14 in. high. The tilting mechanism shown is subject to specification.

The pot shown in Fig. 2 measures 3½ in. across the crucible and has a capacity for 10 lb. of lead.

Engineering Products Corporation "Epco" Dust Mask

Two types of "Epco" dust masks are being manufactured by the Engineering Products Corporation, 64 Wall St., New York, N. Y. Type A is for short-period use and it is intended to be worn when cleaning boilers or under other similar conditions.

Type B, illustrated, is lighter and is intended to be worn for long

Engineering Products Corporation "Epco" Dust Mask

periods where a ventilated mask is necessary, as when paint spraying or sandblasting.

The masks are made from OD twill material and are hemmed and shrunk.

The vision glasses are of two-ply, laminated, non-shatterable glass.

News of the Week

Detroit Growing as Center of Aircraft Industry

Developments of the past few weeks have given Detroit a boost as the aircraft center of America. Three manufacturing companies in the United States have announced plans to move to Detroit. These are the Fisk Co., of San Francisco, makers of cargo carriers and three passenger planes; the Swallow Co. and the Travel Air, Inc., of Wichita, Kansas, makers of similar products

The announcements by Henry Ford and Captain Edward V. Rickenbacker of the development of air-cooled engines has further stimulated the interest of commercial airplane manufacturers in Detroit. C. Harold Wills will soon announce an engine of the same type. Packard airplane engines are already made here.

The Stout Metal Airplane Division of the Ford Motor Co. is manufacturing and selling planes. The Buhl & Verville Aircraft Co., of Detroit, is developing a plane. The Aircraft Development Corporation is working with the government on a metal balloon. This company makes mooring masts for dirigibles and is preparing to build all-metal dirigibles for sale.

The Ford engine, which will power the coming "Ford of the Air," will be an eight-cylinder, air-cooled X-type motor, developing 200 hp., weighing about two pounds to the horsepower, and having all the economical characteristics of the Ford automobile motor. A short rigid crankshaft is enclosed in a barrel case. Around this case are four banks of two cylinders each, set at right angles to each other. Each complete set of four cylinders operates on one arm of the crankshaft, with a new connecting rod arrangement that does away with the "master rod" usual in radial engines.

The cylinders are steel, and fluted for air cooling. The cylinder heads are an alloy composition and also are fluted. The valve seats are bronze, and are shrunk into place.

The Rickenbacker development is a five-cylinder radial, air-cooled engine which is designed especially for use in commercial planes.

New York Safety Congress to Meet at Syracuse

The ninth annual industrial safety congress and exhibit of the New York State Department of Labor will be held in Syracuse, with headquarters at the Hotel Onondaga, Nov. 30, and Dec. 1, 2 and 3. Business sessions will be held morning and afternoon of Dec. 1, 2 and 3 in the Mizpah Auditorium. The safety show will be held in the ballroom of the Onondaga Hotel on Nov. 30 to Dec. 3, inclusive. The New York State Society of Industrial Medicine will hold its annual meeting in conjunction with the congress.

The committee on plan and scope has decided on the above dates and has chosen Syracuse because of its central location. The program is being whipped into shape.

Airplanes to Use Brakes in Landing

Brakes on airplanes, to be used exactly as are those on automobiles, will have a practical try-out as soon as experiments are completed at Farmingdale, L. I., by the Fairchild Airplane Manufacturing Corporation on a new type of commercial photographic monoplane.

The device, which is part of the wing and similar in construction to the ailerons, is operated by a lever in the cockpit resembling an ordinary hand emergency-brake. Manipulation, as a result of calculations based on six months' wind-tunnel experiments, shows a speed reduction of 12 per cent in landing.

The purpose is to build a slow-landing commercial plane, as fast landing is one of the features at present retarding development of aviation. Few planes with great enough speed to be useful are now able to land in small fields, and the device is expected to play a part in overcoming this difficulty.

Founders Association to Meet Next Week

Arrangements have been completed for the twenty-ninth annual convention of the National Founders Association, which will be held in the Hotel Astor, New York, on Nov. 18 and 19. The feature of the meeting this year will be the joint conference between agricultural, industrial and transportation executives. This conference is a part of the movement to promote a better understanding between industry and agriculture in which several of the more important trade and farm organizations are interested.

The usual program of the Founders meetings will be followed. Several papers of general interest to the metal-working trades will be presented by prominent speakers. Among the more specific subjects to be covered are: "How Taxes Affect Railroad Costs," by R. H. Aishton, president of the American Railway Association; and "The Need for Improved Foundry Methods to Overcome Foundry Labor Shortage," by H. M. Lane, president of the H. M. Lane Co., of Detroit.

Engineers Agree on Piston Displacement

The racing cars that will compete for championship laurels on the tracks and speedways of the country next year will be equipped with engines of approximately half the piston displacement of a present-day Ford car. According to an announcement from the national headquarters of the American Automobile Association, automotive engineers, speedway and track managers, racing drivers and the A. A. A. contest board, which supervises official racing, are in accord that the time has come to reduce the size of the engines operating in championship events. The new maximum displacement will be only 91¼ cu.in. as compared with the present displacement of 122 cu.in.

It was made clear that the new standard will be obligatory only on the racing cars competing at championship events held under the sanction of the A. A. A. contest board and does not apply to races conducted without official sanction and which do not count for championship points or for official records.

Steel Industry Progressive in Wage Adjustment

A broad and distinct tendency toward rising "real" wages, that is wages measured in terms of what the worker can buy with his earnings, is traced by the National Industrial Conference Board in a comparative study of representative industries.

Increased application of power, better utilization of labor, mechanical ingenuity and managerial efficiency, according to the board, are steadily tending to reduce unit cost of production, thereby cheapening the general cost of living with resulting increasing prosperity for all.

While this tendency is not equally noticeable in all industries, the differences in wage levels and cost of production are largely attributable to the different degree of efficiency of production prevailing in the respective industries.

The iron and steel industry, according to the analysis, is a striking example of what progressive, modernized methods can do. While wage levels in the iron and steel industry are now about 140 per cent above the pre-war level, the average price of its products at present is only about 34 per cent higher than in 1914. In other words, while wages of iron and steel workers are nearly two and a half times as big as they were before the war, average prices of iron and steel products have risen only about a third.

The Business Barometer

This week's outlook in Commerce, Finance, Agriculture and Industry based on current developments

By Theodore H. Price
Editor, *Commerce and Finance, New York*

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IT has become almost impossible to discuss business conditions in the United States without referring to some economic abstractions.

It is generally agreed that the continued advance in the stock market is due to the superabundance of credit. The National City Bank of New York, in its latest review, finds an analogy for the movement in the crevasse or break in the levee through which a flood in the Mississippi River sometimes escapes to inundate the surrounding country. The implication is that the stock market is the only field that is or will be flooded.

Sooner or later the advance in the stock market must carry prices to a point at which only the foolhardy will buy, and those who have the good sense to take their profits will put them in the bank or reinvest them. Many are now of the opinion that the investment fund thus created will find its way into the commodity markets and bring about an advance in consumable merchandise that will be quite as sensational as the boom in stocks.

In support of this argument attention is called to the decrease in the purchasing power of money. In round figures $1.60 is now required to purchase what could have been bought for $1 before the war. Therefore it is predicted that commodity prices will attract buyers because they are in many cases below what was thought to be reasonable before the war.

By using the rule of three in applying this argument to the price of Chicago December wheat, for example, the following equation is evolved: ($1.51 is the present price of wheat and X represents the equivalent price in pre-war money)

160 : 100 :: 1.51 : X .
160X :: 15100
X :: 94

By using this method the following comparison between present prices and their equivalents in pre-war money has been educed. The list includes only the more important raw products:

	Present Price in Current Money	Equivalent Price in Pre-War Money
Cotton, lb.	$0.19	$0.12
Wheat, bu.	1.51	0.94
Sugar, raw, lb.	0.022	0.0134
Coffee, lb.	0.195	0.122
Rubber, lb.	0.96	0.60
Silk, Sinshiu No. 1, lb.	6.80	4.20
Wool, lb.	0.7797	0.4873
Pig iron, ton	22.75	14.22
Steel, ton	33.50	20.90
Copper, lb.	0.1477	0.092
Lead, lb.	0.095	0.059
Tin, lb.	0.64	0.40
Coal, ton at mines, bituminous	2.15	1.34

The theory upon which the foregoing is based may or may not be sound, but the general acceptance of the idea that present prices are not really high as compared with pre-war values is at last inducing some merchants to abandon the hand-to-mouth policy so generally followed until recently.

As a result, there has been some anticipatory buying in the merchandise markets, and goods are being ordered in larger quantities than formerly. The same influences may perhaps have been at work on the Exchanges were staple commodities are speculatively dealt in. On these exchanges, the general tendency of prices has been upward, and while technical reasons for the improvement are given in each instance, it would be unwise to disregard the broader significance of a movement so inclusive.

The list could be extended, but, as given it is sufficiently comprehensive to indicate the upward tendency of commodity prices referred to. If this tendency means inflation, a demand for higher wages will be one of its consequences. As bearing upon this possibility it is to be observed that 200,000 railroad trainmen are demanding an advance in wages that will aggregate $25,000,000 a year, and that building contractors in several of our larger cities are bidding above the union scale for the skilled labor they require.

The developments thus noted may be simply byproducts of the boom in the stock market that is attracting world-wide attention. An inflation of values which would include the commodity markets is unpleasant to contemplate, and it is to be hoped that it will not occur. The careful observer, however, cannot fail to be impressed by the conditions described, and as a general advance in the price of commodities would speedily absorb the over-supply of credit, extreme caution should be observed in assuming that there is no limit to the expansion.

Conditions abroad are meantime becoming less satisfactory. The predicament of the French government is apparent in the price of francs, which have declined to 3.89, the lowest figure for the year. As a direct result, there is a boom on the Paris Stock Exchange, where investors are trying to exchange the depreciated franc for securities that represent real property. In an endeavor to recover her foreign trade, Great Britain has removed the embargo on foreign loans. The result may be an advance in the London rate.

In any event, extreme circumspection is desirable, for it is beginning to be evident that, unless the advance in the stock market and the land booms are automatically checked, the spirit of speculation will spread until it includes the whole commercial plexus and greatly increases the hazards of ordinary business.

The weekly statement of the Federal Reserve system shows a loss of $10,000,000 in gold, an increase of $47,000,000 in bills discounted.

What's Doing in Industry

The unusual volume of fall business that was reported during October continues to hold up through the first part of this month. Sales and new inquiries in practically every important industrial center have showed a steady increase and present opinions agree in predicting that November will equal the previous month in total volume.

The leadership has been taken away from Detroit by the combined efforts of other large centers. Cincinnati reports increases in sales and inquiries from automotive sources. Milwaukee sales have been far above the average for this time of the year, with every indication of continued activity. Detroit now reports orders from railroads, with the automotive industry still buying some equipment.

The Southern territory is enjoying a widespread business improvement and railroads are expected to be in the market for much needed machine tools. Up through New England those shops working on automotive parts are working to capacity and have been good customers of machine tool dealers. New York is running along smoothly with export business beginning to take on a more important outlook. Philadelphia reports a substantial increase in volume of sales.

General business conditions are good, but it is evident that unless the advance in the stock market and the land booms are checked there is likely to arise a condition that will increase the hazards of ordinary business.

The Industrial Review

Progress of the machinery and machine-tool business in various parts of the country

THE following reports, gathered from the various machinery and machine tool centers of the country, indicate the trend of business in these industries and what may be expected from the future:

New York

The volume of machine tool sales in this territory is riding along satisfactorily on the momentum that was attained during October. The first week in November saw the continuation of buying activity, with more inquiries coming from sources that had done little buying this year.

One fact of particular interest is the activity of builders of airplanes and airplane motors. Several orders have been placed in this market by these people, and it has opened up a new avenue of development for dealers and manufacturers.

Industrialists, however, continue to be the best customers. Orders are coming at regular intervals for special automatic machinery, presses and grinding machines. While no large orders have been recorded, there is enough business in single machines to warrant a more optimistic feeling as to the future.

Export business has improved considerably in the past month. Russia is reported in this market for a substantial quantity of small hand tools and miscellaneous shop equipment. Germany and France have also been more active buyers.

Orders placed last week included: One 20-ton crane for the De Laval company, a 10-ton crane for the New York and Westchester Ry., a 5-ton crane for the U. S. Cast Iron Pipe Co., two horizontal boring and drilling machines for the Marion Steam Shovel Co., a three-hundred ton wheel press for the Briggs & Turives Co., a vertical boring and milling machine and two large lathes for the Treadwell Engineering Co. Also one jig boring machine, each, for the Westinghouse, Harley-Davidson and Delco companies.

New England

The machine industry in the New England district approaches maximum activity, with trade continuing on the upcurve. Buying is principally by the automotive industry and companies having contracts for parts production and machinery required for production in that trade. Requirements for the electrical industry and radio manufacturing are also notably conspicuous.

There is more business in more localities. Principal automobile builders are planning increased production and buying accordingly.

Employment has increased from 10 to 18 per cent in companies with automobile parts contracts; and working schedules have been increased 10 to 15 per cent in hours. Machinery salesmen working through the territory report the best buying is by companies allied with the auto trade.

Philadelphia

Machinery and machine tool business in the Philadelphia area continues in a satisfactory condition. A substantial increase in the present volume over that of a month ago is noted, and most manufacturers and dealers predict an improvement of this situation during the winter. This estimate is based upon inquiries received from a widely distributed area.

Jobbers of used machinery, especially those dealing in iron working tools, wood working machinery and power presses, report business somewhat spotty, with the situation about where it was last year. Indications were for a general advance, it was said, based upon requests which have come from many sources.

Several steel foundries in and around the city report that business has shown an increase. The announcement by the city administration that $9,000,000 will be cut from the building program for the Sesqui-Centennial Exposition, scheduled to open next year, was a disquieting factor in the structural steel and other building materials lines. Construction costs of exhibit buildings will be limited to three million dollars.

Milwaukee

Sales of metal-working equipment are being maintained at or slightly above the average for October, which proved to be one of the most active months of this year. Inquiry is of a more encouraging nature and it is expected that November and December will produce a healthy volume.

Manufacturers of equipment are on schedules that represent a substantial gain over the midsummer period and at least equal to the average of the January-May period of the current year. Difficulty is reported by employers in procuring skilled labor for machine shops, and the scarcity of foundry workers, particularly molders, is growing more pronounced.

In addition to the material list of equipment being purchased by the A. O. Smith Corporation, another large list is in prospect for another shop for which contracts have just been awarded. The Smith company was the best customer in the Milwaukee district in 1925, and its purchases will doubtless run well into the new year.

Garage and repair shop construction in Milwaukee and vicinity has been confined mostly to the smaller units, but at present three or four of the principal distributors of passenger cars and trucks are starting work on new buildings. This construction usually means a fairly heavy demand for miscellaneous tools, machinery, equipment and fixtures, derived principally from Milwaukee jobbers and manufacturers.

Cincinnati

Machine tool manufacturers in Cincinnati report a good volume of sales booked in the past week, and state that an encouraging number of good-sized lists have been submitted. Some plants have added to their working forces and there is increased activity in practically all shops.

One gratifying feature of the market pointed out is the fact that concerns which hitherto have been unheard of are purchasing machine tools and sending in inquiries. This is regarded as an indication that business expansion has begun in at least a small way in various lines of the metal trades and general manufacture, and more orders of this kind are expected to follow.

Selling agencies report that there has been considerable improvement in their markets in the past week. They state that they have found an increased activity among concerns in the metal trades and also among industrial users of machine tools.

Once more the purchases made by concerns in the automotive industries form the principal feature of the week's market. A good-sized order from a leading manufacturer of agricultural implements is reported. Taken as a whole, orders and inquiries have been evenly distributed over the country, and they are well balanced as to sizes and types of tools.

Railroads have made some purchases of single tools and it is thought that orders are about to follow for lists that have been sent out from time to time. The purchases of concerns in the electrical industries have been confined to replacements.

Detroit

Although the total volume of sales in machinery and machine tools in the Detroit district does not show any gain, the market appears to be extending to include certain lines of industry where sales during recent months have been far from heavy.

This is noticeably true in railroad circles, the first evidences of increased buying on their part presenting themselves during the past fortnight. C. K. Bowker, general manager of the central region of the Grand Trunk, has announced plans of his company to expend something like one and one-half million in a new roundhouse and machine shop at Pontiac, a few miles north of Detroit. This program calls for an increase in trackage to care for 1,800 cars instead of the 450 at present, the trebling of the capacity of the roundhouse, and the expenditure of several thousands for new equipment for the machine shop. The Pennsylvania Railway System is preparing to launch an extensive building program which will mean the expenditure of much money in the Detroit facilities.

Little change in the automotive field has occurred during the past week. Buying continues in many of the plants, although some machine tool men report a slight slackening in the volume of orders.

Southern District

Business in the Atlanta district continues to improve. Sales in the last half of October were better than the first half of the month, while the month as a whole showed a fairly substantial improvement over the corresponding month of last year.

Industrially, this district is in the most prosperous shape it has known in the past four or five years, hence the fall and winter outlook for machinery and tools is very good. This is further borne out by the volume of inquiries reaching the Atlanta market from the principal buying sources, which are much heavier than usual at this time of the year. Further evidence of an excellent outlook is seen in a cotton crop exceeding 15,000,000 bales, one of the largest yields in some years.

Information emanating from reliable sources shows a substantial improvement in production for every one of the principal Southern industries the past two months, including brick, textiles, furniture, metal products in the Alabama territory, etc., as compared with the same period last year.

Contractors' equipment and machinery is still active, as construction continues unabated all over the South.

Smaller machine shops continue to buy to some extent, but largely of used or rebuilt equipment. Service station sales also continue fairly good in used equipment.

Railroad business is excellent this fall in the Southeast due to big crops, heavy construction activity, and increased industrial production, hence the outlook for heavier machinery sales to this source is regarded as promising.

What the Railroads Are Doing

The Baltimore & Ohio and the Lehigh Valley have joined the list of railroads experimenting with an oil electric locomotive for use in metropolitan centers. The engines these railroads have purchased are the product of the combined efforts of the American Locomotive Co., the General Electric Co., and the Ingersoll-Rand Co., and are similar to those recently bought by the Central Railroad of New Jersey and the Long Island.

The Central Railroad of Georgia has ordered five mountain-type passenger locomotives from the Baldwin Locomotive Works. The Canadian National Railways has ordered 43,229 tons of rails from the British Empire Steel Corporation in addition to 6,950 tons of tin plate, 2,225 tons of angle bars and 816 tons of spikes and bolts. This steel company has just completed an 18,000-ton order from the Canadian Pacific

The New York Central announced the allotment of its tonnage of steel rails for 1926 recently as follows: 88,500 tons go to Bethlehem Steel Co., 80,445 tons to the Illinois Steel Co., 18,800 tons to the Carnegie Steel Co., and 19,000 tons to the Inland Steel Co. Of this quantity 155,000 tons have been released for prompt shipment and the balance taken under option subject to future specifications. The total tonnage purchased and optioned is 206,745 gross tons.

An investigation of the condition of equipment on the Western railroads made public last week, indicated that they are going into the last quarter with tractive power and location of cars better than at this time in 1924. The condition of freight car equipment is not quite so good as last year, due to the fact that the carriers have not been replenishing their stock as rapidly this year as last.

Since Oct. 1 the following roads have announced increases in the tractive power of locomotives: Burlington, 0.1 per cent; Great Western, 0.5 per cent; Rock Island, 1 per cent; Illinois Central, 1.7 per cent and Missouri Pacific, 10.5 per cent.

The Lima Locomotive Works has received an order from the New York Central R.R. for 25 of the largest Mikado engines ever ordered by that road. The weight of each engine, without tender, is approximately 193 tons.

The General Railway Signal Co. has received an order from the Southern Railway for a complete block signal system for the operating division from Morristown, N. C., to Biltmore, N. C., about 100 miles. The system involves the use of the latest type color-light signaling, employing alternating current control of the absolute-permissive type.

It has also received an order from the Louisville & Nashville for automatic block signals between Mobile, Ala., and New Orleans, La., approximately 140 miles. This contract is an extension of the present signaling, most of which has been furnished by the General Railway Signal Co. Semaphore signals are to be used in connection with the absolute-permissive type of control, with its well-known advantage in expediting train movements.

Fifty-one steam railroads are using motor trucks to handle freight, according to the National Automobile Chamber of Commerce. Twenty railroads, or their subsidiaries, are using more than 219 motor buses.

Ten railroads have established routes parallel to some of their rail lines, five have substituted bus for rail service on branch lines, while two are using buses as feeders through territory not previously served by rail. Three railroads are using buses through arrangements made with bus operators as to ticket interchangeability or as to service in place of discontinued local trains.

Fifteen roads are studying the possibilities of transporting freight by trucks, contemplating either installing them for the first time or adding to their present truck services.

More than 496 gasoline or gas-electric rail motor coaches are being operated by 190 steam and electric railroads. One year ago 483 rail motor vehicles were in use on 174 rail lines.

Personals

ARVA STROUD, importer and exporter of machine tools and special equipment, of 233 Broadway, New York, has gone to Europe. Mr. Stroud will spend several weeks visiting industrial centers abroad.

C. M. TALHELM, of the Landis Tool Co., sailed on Oct. 21 for Germany. He expects to be gone several weeks.

RALPH R. BROWNING has been elected president of the Oxweld-Acetylene Co., of New York.

H. FARROW has been appointed manager of the stamping department of the Transue-Williams Steel Forging Co., of Alliance, Ohio.

H. TERHUNE has joined the sales staff of the Erie Foundry Co., of Erie, Pa. Mr. Terhune was formerly associated with the Billings & Spencer Co., and also with the Chambersburg Engineering Co.

EDWARD W. WEILER, formerly of the General Electric Co., has become associated with the Eureka Tool and Machine Co., of Newark, N. J.

PHILIP A. LANG, of London, England, special European representative of the Westinghouse Electric and Manufacturing Co., and formerly works manager of that company's plant at East Pittsburgh, Pa., is in this country, visiting the home plant of the company and consulting with officials.

CLARENCE H. WOLFE has been appointed general superintendent of the Dalton Adding Machine Co., of Cincinnati. Mr. Wolfe has been for ten years chief engineer of the company.

H. I. MARKEY has recently been made district manager for the Diamond Chain and Manufacturing Co., of Indianapolis, in the New York territory with offices at 1011 Chestnut St., Philadelphia. Frank Smiley succeeds Mr. Markey as district manager of the West-Central territory, and is located at 855 Leader-News Bldg.

GEORGE H. WARING, of Grand Rapids, Mich., has sailed for Rosario, Argentina, where he will be a consulting engineer for the Compania Hispano-Americano de Electricidad.

J. J. CARTER has become factory manager of the Olds Motor Works, Lansing, Mich. He succeeds John Scott, who recently resigned to go on an extensive trip abroad.

A. H. MOORMAN has been elected vice-president of Wills Sainte Claire, Inc., according to an announcement by C. Harold Wills, president of the company. Mr. Moorman has been with Wills Sainte Claire, Inc., since 1923 in the capacity of treasurer and controller.

W. E. MOBERLY has joined the staff of the Davis Boring Tool Co., of St. Louis, as special railroad sales representative. Mr. Moberly was for several years associated with the American Car and Foundry Co., and more recently with the Pullman Co., in Chicago. He resigned from the latter company to join the Davis organization.

WILLIAM G. CLYDE has been elected president of the Carnegie Steel Co. Mr. Clyde in recent years has devoted his energies to the sales end of the steel business. He is, however, a practical steel man, having an unusual equipment for his chosen end of the work.

"The Human Factor"

In a recent announcement from the Massachusetts Society for Mental Hygiene the information is given that on Nov. 15 the organization will issue the first number of a new bulletin which it will publish regularly as a definite part of its program.

The new bulletin will be called "The Human Factor," and will cover various phases of industrial relations presented in such a way as to interest the busy executive. The editorial directorship of the bulletin will be under Dr. Henry B. Elkind, medical director of the society.

News of the Automotive Industry

The Lawson Aircraft Co., of New York, has leased the factory at Berckman St. and North Ave., Plainfield, N. J., formerly owned by the Standard Aero Co., and after alterations will engage in the manufacture of aircraft for the United States and foreign governments as well as for commercial air lines and private individuals. Alfred W. Lawson is the chief designer. The location of an airport as a terminal will be decided upon soon. The Standard Aero Co. used the plant to make aircraft during the World War.

Frank H. Russell, vice-president of the Curtiss Aeroplane and Motor Co. states that a contract will be signed in a few days for a large number of Curtiss D12 airplane motors for use in British government planes. It is said that this is the first production order for American airplane motors ever placed by a foreign country. It is understood from unofficial sources that this order will involve approximately $600,000.

Production demands have forced the Reo Motor Car Co., Lansing, Mich., temporarily at least, to abandon the plan by which employees were given a full Saturday holiday by working longer hours during the other days of the week. Orders on hand are pressing the plant to its utmost.

The greatest sales, production and earnings in the history of the Packard Motor Car Co., are recorded in the annual report signed by Alvan Macauley, president, for the year ended Aug. 31. The company showed net earnings of $12,191,081.21. Sales during the year amounted to $60,475,989.89, while the number of passenger cars produced was 24,246.

Automobile production in October, according to reports received by the National Automobile Chamber of Commerce totaled 454,327 cars, exceeding any previous month in the history of the industry and comparing with 404,376 in the previous record month, May, 1923.

The October total shows a gain of more than 120,000 cars over September when 332,759 were produced and compares with 293,356 in October, 1924.

The sensational gain in production during last month when schedules normally decline is attributed to increased operations in Ford plants which have been behind in recent months, as well as excellent foreign demand.

October brings total production this year to practically the full production of 1924 around 3,620,000 cars and trucks.

Orders have been placed by the Olds Motor Works, at Lansing, Mich., for additional equipment which will enable the plant to double its production of Oldsmobiles. More ovens will be installed in the adjoining plant of the Fisher Body Corporation, all present ovens being on a 24-hour schedule now.

In the main assembly buildings of the Paige-Detroit Motor Co., a motor conveyor for the new engines, with a capacity of more than 300 every eight hours, has been installed. The motor paint-oven has been enlarged 50 per cent and the chassis assembly conveyor has been increased in capacity. The capacity of the enameling oven has been similarly increased. The two final-assembly conveyors have been remodeled to handle the new model. Besides these major changes, much machinery for the handling of the new bodies and parts, and for the manufacture of the new units will be installed.

Obituaries

STEWART A. DAVIS, vice-president of the American Sheet and Tin Plate Co., a subsidiary of the United States Steel Corporation, died unexpectedly on Nov. 6 at Pittsburgh.

ARTHUR H. FLEET, sales manager of the Cutler-Hammer Manufacturing Co., Milwaukee, died on Oct. 30 at Lynchburg, Va., after a lingering illness. He was 45 years of age. Mr. Fleet was obliged to abandon active duties about eight months ago. He was a graduate of the Virginia Polytechnic Institute, and after teaching and later being connected with Southern railroads, joined the Cutler-Hammer company in 1912.

Business Items

At a recent meeting of the board of directors of the Lynd-Farquhar Co., of Boston, Howard L. Rich was elected to the board to serve the unexpired term of the late Robert J. Lynd, president of the company. Following the reorganizing of the board, Charles S. Farquhar was elected president to succeed Mr. Lynd, and Mr. Rich was elected vice-president. Harold F. Furber was re-elected secretary of the company.

The Milwaukee Electric Crane and Manufacturing Co., Inc., operating a large crane and tool works in Milwaukee, has changed from a New York to a Wisconsin charter. The new name of the concern is the Milwaukee Electric Crane and Manufacturing Corporation. The capital of the new company is increased over the former corporation. The official personnel is but slightly changed. M. A. Beck, is president; Henry S. Wright, vice-president, and M. P. O'Brien, secretary and treasurer. Henry M. Thompson, of Milwaukee, is an additional member of the board.

The Roller-Smith Co., of 233 Broadway, New York, announces that its Knoxville, Tenn. agent, the Tennessee Engineering and Sales Co., has opened a branch office at 493 No. Boulevard, Atlanta, Ga., and all Georgia business will be looked after from that office. The company also announces that its New England agent, the Detweiler-Bell Co. now has its main office at 101 Milk St., in Boston, and has a branch office at 52 Temple St., New Haven. Paul G. Detweiler and R. H. McCormick are located in the Boston office and F. M. Lord is in the New Haven office.

A new plan for the reorganization of the New Britain Machine Co., of New Britain, Conn., has been submitted to stockholders. The suggested plan, originating with the preferred stockholders' committee, has received the approval of the board of directors and the common stockholders' committee.

The plan calls for the establishment of a new class of preferred stock. This is to be 7 per cent cumulative preferred upon which the deferred dividends are to be paid from time to time. The Class B, will be that preferred stock not exchanged. Dividends will first be paid on the Class A. The common stock will be declared "no par value."

Reorganization is necessary before dividends can be resumed. Dividends on the preferred stock were defaulted in 1921, and no payment could be made while a deficit existed. The deficit, which was considerable, has been wiped out largely through the adjustment of government claims and a reserve of about $325,000 has been built up.

Deposit of 75 per cent of certificates in the depositaries—the New Britain Trust Co., of New Britain, and the Phoenix National Bank, of Hartford, Conn., is necessary to proceed with reorganization, which will be accomplished in January or February of next year.

The Davis Boring Tool Co., of St. Louis, has established a branch office in the Book Bldg., Detroit, and will be represented in that territory by A. J. Heaney, mechanical engineer, and Jack Mull, sales representative.

The Charles M. Hoffman Co., manufacturers representatives, of Kansas City, Mo., will represent the Oil Jack Co., Inc., of New York, in the Southwest.

Trade Catalogs

Alloy Steels. Vanadium Alloys Steel Co., Latrobe, Pa. A chart, 12x18 in. cardboard, has been published to show the uses of thirteen brands of "Vasco" steel. Heat and temper charts are shown in color with the corresponding temperatures in centigrade and fahrenheit degrees.

On the reverse side of the chart is an alphabetical list of approximately 180 steel products with the proper grade of "Vasco" steel and its treatment shown.

Compressors. Pennsylvania Pump and Compressor Co., Easton, Pa. The No. 125 General Products Catalog in sixteen 8½x11-in. pages illustrates and describes the complete line of products of this company. These include steam- and electric-driven single-stage and cross-compound air compressors as well as gasoline-engine-driven portable units. Vacuum pumps, aftercoolers and centrifugal pumps are included.

Furnaces, Industrial. The Chicago Flexible Shaft Co., 5600 Roosevelt Rd., Chicago, Ill., has prepared an illustrated folder describing the Stewart industrial furnace equipment.

Hoists, Portable. Sullivan Machine Co., 122 South Michigan Ave., Chicago, Ill. Bulletin No. 76-F is devoted to the Sullivan line of "Turbinair" portable hoists. Several models of the hoist are described and illustrated and the principles of operation are clearly explained. Many photographs are shown of actual installations of the equipment.

Washers, Safety. Geo. W. Perks & Co. have issued a small circular to describe the Perks safety washers for grinding wheels. The action of the rubber surface of these steel washers is briefly described.

Pamphlets Received

A Non-Technical Summary of Research on the Application of Leather Belting. Twenty-eight 6x9-in. pages. Published by the Leather Belting Exchange Foundation, Cornell University. Distributed by the Chas. A. Schieren Co., 37 Ferry St., New York, N. Y. This booklet in a thorough but readable fashion relates the experiments conducted by the foundation at Cornell University. Many photographs and diagrams are used in illustrating the text. The information is of a practical and useful nature.

Foremanship. Department of Manufacture, Chamber of Commerce of the United States, Washington, D. C. Forty-eight, 6x9-in. pages. This pamphlet will be found a valuable one on the fundamentals in the development of industrial foremen. The bulletin in a practical and concrete way explains the methods developed by the experience of manufacturing organizations as to the beginning and sources of instruction, the contents and methods of the course, the personnel and handling of the meetings and the real value of the foremanship training program. The ideas are not indefinite, theoretical ones, but are basic and detailed. The method of foremanship training is set out in black and white so that it could be readily adopted or developed and adapted by anyone interested.

Patents and How to Obtain Them. By Watson E. Coleman, 644 G St., N. W., Washington, D. C. A small 25-page booklet describes the method and procedure for obtaining patents, trade-marks and copyrights in the U. S. and also contains abstracts of decisions relating to patents and inventions.

Patents, Law and Practice. By Richards and Geier, 277 Broadway, New York, N. Y. The third edition of this fifty-six page, 6x9-in. book contains a digest and schedule of charges for United States and foreign patents. The procedure is entered into with considerable detail in a concise and orderly manner. The rights of inventors are clearly described as are many other problems involved in the general process of patent applications and grants.

Trade Marks and Unfair Competition. By Richards and Geier, 277 Broadway, New York, N. Y. The fourth edition of this 48-page book explains the theory and development of trade marks as well as their registration in the United States and foreign countries. Trade mark laws are concisely stated and explained and the rights of parties concerned are defined. The material collected will be found valuable to those interested in patents and trade marks.

Seventy-five Years of Gas Service in Chicago. By Wallace Rice. The Peoples Gas Light and Coke Co., Michigan Ave. and Adams St., Chicago, Ill. This fifty-eight page, 6x9-in. book is a history of the origin and growth of the gas industry in Chicago, together with an account of the various gas companies now consolidated into one organization. Many old drawings are reproduced, showing views of Chicago in its early days. Considerable Chicago history is worked into the story of this organization.

Calendar of Local Meetings

National Association of Cost Accountants

Philadelphia Chapter. Nov. 13. "Relation of Sales Quotas and Credits to Production and Costs," by J. W. Hallman.

Mohawk Valley Chapter. Nov. 16. "Materials Budget, or Costing the Materials."

American Society of Mechanical Engineers

Los Angeles Chapter. Nov. 17. "Recording the Unrecorded Cost," by E. C. D. Price and H. H. Baskerville.

Cleveland Chapter. Nov. 18. "Business Forecasts and Labor Control and Distribution."

Pittsburgh Chapter. Nov. 18. "Cost and Budget Systems for Public Education," by Dr. Frank Haas.

Rochester Chapter. Nov. 18. "The Elimination of Clerical Work by Simplified Cost Finding," by C. H. Scovell.

Syracuse Chapter. Nov. 18. "Questions the Executive Expects the Cost and Accounting Department to Answer," by F. L. Sweetster.

Boston Chapter. Nov. 19. "Reducing Inventory Investment Through Turnover," by Clifford B. Wright.

Buffalo Chapter. Nov. 19. "The Cost of Collections."

Chicago Chapter. Nov. 19. "Planning for Future Financial Position," by F. M. Kasch.

San Francisco Chapter. Nov. 23. "Cost Accounting in the Printing Trades."

Detroit Chapter. Nov. 28. "Methods of Taking Inventories."

Society of Automotive Engineers

Buffalo. Nov. 17. "Commercial Aviation," Hotel Statler, 8 p.m.

Cleveland. Nov. 19. Sectional meeting.

Washington, D. C. Nov. 20. "Ordnance Automotive Equipment," Cosmos Club.

Chicago. Nov. 20. Sectional meeting, C. F. Kettering, speaker.

San Francisco. Nov. 24. Northern California sectional meeting, "Mechanical Traffic Control," Engineers Club.

American Society for Steel Treating

Buffalo. Jan. 21 and 22. Winter sectional meeting, Hotel Statler.

Hartford. June. Spring sectional meeting.

Forthcoming Meetings

American Institute of Steel Construction. Annual convention, White Sulphur Springs, W. Va., Nov. 11 to 14. C. F. Abbott, executive secretary, 350 Madison Ave., New York City.

National Founders' Association. Annual Convention, Hotel Astor, New York, Nov. 18 and 19. J. M. Taylor, executive secretary, 29 So. La Salle St., Chicago.

American Society of Mechanical Engineers. Annual meeting, Engineering Societies Bldg., 29 West 39th St., New York City, Nov. 30, to Dec. 4. Calvin Rice, secretary, Engineering Societies Bldg., New York.

National Exposition of Power and Mechanical Engineering. Fourth annual event, Grand Central Palace, New York City, Nov. 30 to Dec. 5. Charles F. Roth, manager, International Exposition Co., Grand Central Palace, New York City.

American Association for the Advancement of Science. Annual meeting, Kansas City, Mo., Dec. 28, 1925, to Jan. 2, 1926. Barton E. Livingston, secretary, Smithsonian Institute Bldg., Washington, D. C.

American Society for Steel Treating. Winter sectional meeting, Hotel Statler, Buffalo, N. Y., Jan. 21 and 22. W. H. Eisenman, secretary, 4600 Prospect Ave., Cleveland, Ohio.

The Weekly Price Guide

Rise and Fall of the Market

Iron and Steel—Iron buying continues in small lots for prompt shipment; market is firm but easing coke prices may retard further rise in pig iron. Scrap quotations higher. Steel sheets are in better demand than a month ago and an upward trend is noted in the principal hot-rolled products. Bars are $2; shapes, $1.90@$2; plates, $1.60@$1.90 per 100 lb. at Pittsburgh mills; these prices represent little change from the Oct. 30 level.

Non-Ferrous Materials—Lead and copper are up ¼c. per lb. in New York warehouses from Oct. 30 level. Zinc and tin are down. Principal among the other price movements of the week were: advances in zinc sheets at New York, Cleveland and Chicago warehouses; fabricated brass and copper in Cleveland; linseed oil and solder at New York.

(All prices as of Nov. 6)

IRON AND STEEL

PIG IRON—Per gross ton, f.o.b.:

CINCINNATI	
No. 2 Southern	$24.05
Northern Basic	24.27
Southern Ohio No. 2	24.77
NEW YORK—Tidewater Delivery	
Southern No. 2 (silicon 2.25@2.75)	28.37
BIRMINGHAM	
No. 2 Foundry	21.00
PHILADELPHIA	
Eastern Pa., No. 2x (silicon 2.25@2.75)	23.16
Virginia No. 2	29.17
Basic	23.16
CHICAGO	
No. 2 Foundry local	22.50
No. 2 Foundry, Southern (silicon 2.25@2.75)	26.55
PITTSBURGH, including freight charge ($1.76) from Valley	
No. 2 Foundry	21.77
Basic	21.77
Bessemer	21.77

IRON MACHINERY CASTINGS—Cost in cents per lb. of 100 flywheels, 6-in. face x 24-in. dia., hub not cored, good quality gray iron, weight 275 lb.:

Detroit	5.00@5.50
Cleveland	4.90@5.00
Cincinnati	5.00@7.50
New York	5.00@5.50
Chicago	5.25@5.75

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the mill base in large lots.

Blue Annealed	Pittsburgh Mill Base	New York	Cleveland	Chicago
No. 10	2.30@2.40	3.89	3.15	3.50
No. 12	2.35@2.45	3.94	3.20	3.55
No. 14	2.40@2.50	3.99	3.25	3.60
No. 16	2.50@2.60	4.09	3.35	3.70
Black				
Nos. 17 to 21	2.95@3.05	4.15	3.75	3.80
Nos. 22 to 24	3.00@3.10	4.20	3.80	3.85
Nos. 25 and 26	3.05@3.15	4.25	3.85	3.90
No. 28	3.15@3.25	4.35	3.95	4.00
Galvanized				
Nos. 10 and 11	3.30@3.40	4.35	4.25	4.00
Nos. 12 to 14	3.40@3.50	4.45	4.35	4.10
No. 16	3.55@3.65	4.60	4.50	....
Nos. 17 to 21	3.70@3.80	4.75	4.65	4.40
Nos. 22 to 24	3.85@3.95	4.90	4.70	4.55
No. 26	4.00@4.10	5.05	4.95	4.70
No. 28	4.30@4.40	5.35	5.10	5.00

WELDED STEEL PIPE—Warehouse discounts are as follows:

	New York Black	New York Galv.	Cleveland Black	Cleveland Galv.	Chicago Black	Chicago Galv.
1 to 3 in. steel butt welded	53%	39%	55½%	43½%	54%	41%
3½ to 6 in. steel lap welded	48%	35%	53½%	40½%	51%	38%

Malleable fittings: Classes B and C, banded, from New York stock sell at list plus 4% less 5%. Cast iron, standard sizes, 36-5% off.

Size, Inches	List Price per Foot	Diameters Inches — External	Diameters Inches — Internal	Thickness Inches
1	$0.17	1.315	1.049	.133
1¼	.23	1.66	1.38	.14
1½	.27½	1.9	1.61	.145
2	.37	2.375	2.067	.154
2½	.58½	2.875	2.469	.203
3	.76½	3.5	3.068	.216
3½	.92	4.0	3.548	.226
4	1.09	4.5	4.026	.237
4½	1.27	5.0	4.506	.247
5	1.48	5.563	5.047	.258
6	1.92	6.625	6.065	.28

SEAMLESS STEEL TUBING—Following base discounts are on 20 gauge or .035-in., round, cold-drawn tubing, ½-in. to 1-in., O.D., weighing 0.17 lb. to 0.36 lb. per ft. Cutting charge per 100 cuts, $1.50 to $1.58:

O.D. Inches	List Price per ft.	Differential Discount	O.D. Inches	List Price per ft.	Differential Discount
½	$0.15	50%	⅞	$0.18	35%
⅝	.16	45%	1	.19	31%
¾	.17	40%			

NOTE—The discounts are to be lowered by the following differentials in the case of regular .10-.30 carbon: 25,000 ft. or over, 83; 15,000 to 25,000 ft., 82; 5,000 to 15,000 ft., 81; 1,000 to 5,000 ft., 80; less than 1,000 ft., 79.

MISCELLANEOUS—Warehouse prices in cents per pound in 100-lb. lots:

	New York	Cleveland	Chicago
Open hearth spring steel (base)	4.00	....	4@4.65
Spring steel (light) (base)	6@7	6.00	6.00
Coppered Bessemer rods (base)	6.05	....	....
Hoop steel	4.49	3.85	4.15
Cold rolled strip steel	6.35	8.25	6.80
Floor plates	5.55	5.60	5.50
Cold drawn shafting or screw	4.15	3.80	3.60
Cold drawn flats, squares	4.65	4.30	4.10
Structural shapes (base)	3.34	3.20	3.10
Soft steel bars (base)	3.24	3.10	3.00
Soft steel bar shapes (base)	3.24	3.11	3.10
Soft steel bands (base)	3.99	3.20	3.65
Tank plates (base)	3.34	3.40	3.10
Bar iron (3.00 at mill)	3.24	3.21	3.00
Drill rod (from list)	60%	55%	60%

Electric welding wire, New York, 3/32, 8.25c.; ⅛, 7.85c.; 5/32 to ¼, 7.35c. per lb.

METALS

Current Prices in Cents Per Pound

Copper, electrolytic (up to carlots), New York			15.62½
Tin, 5-ton lots, New York			64.00
Lead (up to carlots) E. St. Louis	9.85	New York	10.75
Zinc (up to carlots) E. St. Louis	8.95	New York	9.75

	New York	Cleveland	Chicago
Antimony (Chinese), ton spot	21.00	20.75	....
Copper sheets, base	22.75	22.95	22.75
Copper wire, base	20.25	17.25	16.75@17
Copper bars, base	21.87½	21.75	21.87½
Copper tubing, base	24.75	25.75	24.75
Brass sheets, base	19.12½	19.37½	19.12½
Brass tubing, base	23.75	24.00	23.75
Brass rods, base	16.87½	17.12½	16.87½
Brass wire, base	19.62½	19.87½	19.62

Shop Materials and Supplies

METALS—Continued

	New York	Cleveland	Chicago
Aluminium ingots, 98 to 99%, 1-15 ton lots	28@29	28.00	28.03
Zinc sheets (casks)	11.75	12.60@12.95	12.00
Solder (½ and ½), (case lots)	40.00	41.00	38@42
Babbitt metal (83% tin)	60.00	72.50	58@63
Babbitt metal (35% tin)	28.00	22.50	30@35
Nickel (ingots) f.o.b. refinery	31.00	.....	.....
Nickel (electrolytic) f.o.b. refinery	38.00	.....	.....
Nickel (shot) f.o.b. refinery	32.00	.....	.....

SPECIAL NICKEL AND ALLOYS—Price in cents per lb., f.o.b. Huntington, W. Va.:

Hot rolled nickel sheet (base)	52.00
Cold rolled nickel sheet (base)	60.00
Hot rolled rods, Grade "A" (base)	50.00
Cold drawn rods, Grade "A" (base)	58.00
Manganese nickel hot rolled rods "E"—low manganese (base)	54.00
Manganese nickel hot rolled rods "D"—high manganese (base)	57.00

Base price of Monel metal in cents per lb., f.o.b. Huntington, W. Va.:

Shot	32.00	Hot rolled rods (base)	40.00
Blocks	32.00	Cold drawn rods (base)	48.00
Ingots	38.00	Hot rolled sheets (base)	42.00
		Cold rolled sheets (base)	50.00

OLD METALS—Dealers' purchasing prices in cents per pound:

	New York	Cleveland	Chicago
Crucible heavy copper	12.50@12.75	11.75	11.75@12.25
Copper, heavy, and wire	12.00@12.25	11.50	11.25@11.75
Copper, light, and bottoms	10.00@10.50	9.75	10.25@10.75
Heavy lead	8.12½@8.62½	7.75	7.75@8.25
Tea lead	7.00@7.50	5.00	6.75@7.25
Brass, heavy, yellow	7.50@8.00	7.25	7.50@8.00
Brass, heavy, red	9.75@10.12½	8.00	9.00@9.50
Brass, light	6.25@6.50	6.25	7.75@8.00
No. 1 yellow rod turnings	8.50@9.00	9.50	7.50@8.00
Zinc	5.00@5.50	4.50	5.00@5.50

TIN PLATES—American Charcoal—Bright—Per box.

		New York	Cleveland	Chicago
"AAA" Grade:				
IC,	14x20	$11.25	$11.45	$11.50
"A" Grade:				
IC,	14x20	8.85	9.40	9.50
	Coke Plates—Primes.			
100-lb.,	14x20	6.50	6.10	7.00
	Terne Plates—Small lots, 8-lb. Coating			
IC,	14x20	7.25	6.95	7.50

MISCELLANEOUS

	New York	Cleveland	Chicago
Cotton waste, white, per lb.	$0.15@0.22	$0.19	$0.20
Cotton waste, colored, per lb.	.10@.15½	.18	.17
Wiping cloths, washed white, per lb	.17¼	36.00 per M	.15½
Sal soda, per 100 lb. keg	2.25	2.25	2.75*
Roll sulphur, per 100 lb. keg	3.75	3.75	4.50
Linseed oil, per gal., 5 bbl. lots	1.02	1.15	1.01
Lard cutting oil, 25% lard, per gal.	.55	.50	.72
Machine lubricant, medium-bodied (50 gal. wooden bbl.), per gal.	.35	.35	.26
Belting—Present discounts from list in fair quantities (½ doz. rolls).			
Leather—List price, 24c. per lin. ft. per inch of width for single ply.			
Medium grade	40%	40%	30–10%
Heavy grade	30–10%	35%	30–5%
Rubber transmission, 6-in., 6 ply, $1.83 per lin. ft.			
First grade	50%	50–10%	50%
Second grade	50–10%	60–5%	50–10%

*In 175 lb. kegs.

Comparative Warehouse Prices

New York	Unit	Current Price	Four Weeks Ago	One Year Ago
Soft steel bars	per lb.	$0.0324	$0.0324	$0.0324
Cold drawn shafting	per lb.	.0415	.0415	.0405
Brass rods	per lb	.1687½	.1687½	.1537½
Solder (½ and ½)	per lb.	.40	.395	.38@.39
Cotton waste	per lb.	.15@.22	.15@.22	14@21
Washers, cast iron (½ in.)	per 100 lb.	7.00	7.00	6.50
Emery, disks, cloth, No. 1, 6 in. dia.	per 100	3.55	3.55	3.38
Lard cutting oil	per gal.	.55	.55	.55
Machine oil	per gal.	.35	.35	.29
Belting, leather, medium	off list	40%	40%	40–2½%
Machine bolts up to 1x30 in.	off list	40%	40%	45%

MISCELLANEOUS—Continued

	New York	Cleveland	Chicago
Abrasive materials—In sheets 9x11 in., No. 1 grade, per ream of 480 sheets:			
Flint paper	$5.46	$5.84	$5.00
Emery paper	10.71	11.00	11.90
Emery cloth	29.48	31.12	32.75
Emery disks, 6 in. dia., No. 1 grade, per 100:			
Paper	1.49	1.41	1.40
Cloth	3.55	2.67	3.55
Fire clay, per 100 lb. bag		.60	.75
Coke, prompt furnace, Connellsville	per net ton 8.00		
Coke, prompt foundry, Connellsville	per net ton 9.50		
White lead, dry or in oil	100 lb. kegs	New York, 15.75	
Red lead, dry	100 lb. kegs	New York, 15.75	
Red lead, in oil	100 lb. kegs	New York, 17.25	

SHOP SUPPLIES

Machine bolts, ¼x1½-in., per 100, $1.70. Discount at New York warehouses on all sizes up to 1x30-in., 40%; 1¼ and 1¼x3-in. up to 12-in., 15%; with cold punched hex. nuts up to 1-in. dia. (plus std. extra of 10%) 30%; with hot pressed hex. nuts up to 1x30-in. (plus std. extra of 10%) 35%.

Carriage bolts, ¼x1½-in., per 100, $1.00. Discount on all sizes up to 1x30-in., 30%.

Coach and lag screws, 1½x$\frac{5}{16}$in., $2.25 per 100, less 40%.

Tap bolts, 1½x¼-in., $1.00 per 100. List plus 35% at New York warehouses.

Bolt ends, 1x12-in., 10c. per lb., less 40%.

Nuts, semi-finished, ½x½-in., 2c. each. Discount 70% for $\frac{5}{16}$-in and smaller and 65% for ⅜-in. and larger.
Case hardened ½x½-in., 6c. each, less 50%.

Rivets, button heads, ¾-in., ⅞-in., 1-in. diam. x2$\frac{1}{16}$-in. to 4$\frac{1}{16}$-in., $5.00* per 100 lb. at New York warehouses; cone heads, same sizes, $5.20* per 100 lb. Rivets, $\frac{7}{16}$x1-in. and longer, 19c. per lb., less 50%. Same discount for tinned. EXTRA per 100 lb. for 1¼ to 2-in. long, all diameters, 25c.; ⅝-in. dia., 35c.; ½-in. dia., 75c.; 1-in. long and shorter, 75c.; longer than 5-in., 50c.; less than 200 lb., 50c.; countersunk heads, 45c.

Washers, cast iron, ½-in., $7.00* per 100 lb. at New York warehouses; ⅝-in., $6.00* per 100 lb.

*For immediate delivery from warehouse.

Machine Requirements and Industrial Construction

Machine Tools and Equipment Wanted

Conn., Bridgeport—J. P. Lee, 621 Lindley St.—hydraulic arbor press 2 to 5 ton sensitive capacity.

Mass., Brookline (Boston P. O.)—P. Hunt 50 Pleasant St.—18 in. panel planer, combination saw, single saw, swing saw, 36 in. band saw, hollow chisel mortiser and tenoner.

Mass., Malden (Boston P. O.)—P. Levine, c/o J. Tuck, Park Square Bldg., Boston, Archt.—tools and equipment for proposed 1 story, 110 x 300 ft. garage on Pleasant St. here. Estimated cost $150,000.

Mass., Newton (Boston P. O.)—Newton Machine Screw Co., Crafts St.—machinery, etc. for new machine shop under construction.

Mass., Roxbury (Boston P. O.)—Stephens Laundry Machinery Co., 20 Kemble St.—plain or Universal miller, 15 in. shaper, 1 to 2 in. and 2 to 4 in. single spindle wood borer, 12 in. single spindle emery grinder.

Mich., Detroit—Bd. of Education, 1354 Broadway Ave.—metal working machinery for shops in Burroughs Intermediate and Central high schools.

Mich., Detroit—Detroit Twist Drill Co.—4 furnaces, heat treating, shell only, oil burning, chambers 28 x 60 in. (used).

Mich., Menominee—Prescott Co., Broadway and Wabash Ave., F. M. Prescott, Pres.—foundry equipment for proposed 1 story 92 x 140 ft. addition to steel foundry. Private plans.

Mo., Jackson—The Evans Mfg. Co., 204 Texas Bldg.—machinery for the manufacture of automobile pumps, including steel tubing, screw machine work, hose connections, etc.

O., Cleveland—A. K. Hoare, Comr. of Purchases and Supplies—will receive bids until Nov. 20 for a mechanical loading device for the Div. of Streets.

O., Mansfield—Mansfield Cylinder Grinding Co.—lathe 20 to 24 in. swing 4 to 6 ft. between centers, piston grinders, tool post grinders, Universal tool grinder, arbor press, babbitting and boring machine for auto connecting rods (used.)

S. C., Saluda—Saluda Lumber Co.—wants data and prices on heading machines for stock cooperage.

Tex., Houston—O. F. Holcombe, Mayor—is receiving bids for furnishing and installing (a) 10 ton electric operated, floor controlled overhead crane, (b) 10 ton hand operated overhead crane.

Va., Norfolk—Parker-Taylor Co.—car wheel lathe 60 in. x 6 ft. centers, belt driven, 200 ton wheel press.

Wis., Oshkosh — Foster-Lothman Mills, 4th and Minnesota Sts.—woodworking machinery.

Wis., Milwaukee—Wisconsin Electrical Mfg. Co., 453 East Water St.—drill press, small tools, etc., for proposed 1 story, 50 x 100 ft. factory for the manufacture of electrical specialties. Estimated cost $25,000.

Wis., Antigo — Vulcan Last Co., machinery for the manufacture of shoe lasts for proposed 2 story plant. Architect not selected.

Wis., Polar—T. D. Kellogg Lumber Co., Superior St., Antigo—power saws, belting, shafting, etc., for proposed 2 story saw mill here. Estimated cost $50,000.

Wis., Waukesha — Manitowoc Church Furniture Co., 1214 Lincoln Ave.—woodworking machinery.

Wis., Wauwatosa—Liberty Foundry Co., 57th and State Sts.—foundry equipment and moulding machines for proposed 1 story, 80 x 100 ft. foundry on State St. Estimated cost $50,000.

Ont., Magnetewan—W. McLachlan, Sr.—complete equipment for new sawmill to replace fire loss. Estimated cost $25,000.

N. B., Bathhurst—G. Eddy Co. Ltd.—woodworking machinery and equipment for plant to replace fire loss. Estimated cost $75,000.

Que., Chicoutimi—La Cie Industrielle de Chicoutimi, 421 Racine St.—sticker and planer.

Que., Chicoutimi — G. Vezina, 639 Ave. Morin (manufacturers sash and doors, etc.) jointer and planer.

Que., La Riviere due Moulin — E. Tremblay—equipment for sash and door manufacturing plant.

Que., Jonquiere—Brassford & Fils, St. Simon St.—dowel machine, matcher, etc.

Que., Roberval—L. Fonderie de Roberval, A. Guimond, Purch. Agt.—machinery for proposed extension to plant.

Que., Roberval—Gagnon & Frere, Perade St. (sash and doors) — moulder, sash sticker, etc.

Que., Roberval — G. Macorte — small lathe, air compressor and other tools.

Que., St. Alexis—H. Bonchard, Victor St.—sticker and planer.

Opportunities for Future Business

Calif., Berkeley — Mann Mfg. Co., 454 Golden Gate Ave., San Francisco, awarded contract for the construction of a 2 story, 120 x 180 ft. machine shop at Dwight Way and 9th St. $45,000.

Calif., Los Angeles — Baash-Ross Tool Co., 5520 Boyle Ave., awarded contract for the construction of a 98 x 200 ft. factory on South Boyle Ave. $100,000.

Conn., Derby — Derby Gas & Electric Co., 22 Elizabeth St., is having plans prepared for the construction of a 3 story, 41 x 85 ft. shop on Housatonic Ave. Estimated cost $50,000. R. W. Foote, 185 Church St., New Haven, Archt.

Conn., Waterbury—American Brass Co., Grand St., awarded contract for the construction of a 3 story, 62 x 137 ft. factory on Jewelry St. Estimated cost $75,000.

Conn., Waterbury—American Metal Hose Co., 67 Jewelry St., awarded contract for the construction of a 3 story manufacturing plant. Estimated cost $90,000.

Ga., Columbus—The Luminus Cotton Gin Co., F. E. Luminus, awarded contract for the construction of a new 1 story, 130 x 220 ft. machine shop in connection with present plant. Estimated cost $50,000.

Ill., Blue Island — Illinois Cooperage Mfg. Co., 220 South State St., Chicago, awarded general contract for the construction of a cooperage plant here. Estimated cost $150,000.

Ill., Chicago — American Can Co., 104 South Michigan Ave., awarded contract for the construction of a 3 story, 148 x 167 ft. warehouse and factory at 6007-6033 South Western Ave. Estimated cost $200,400.

Ill., Waukegan—Chicago North Shore & Milwaukee Ry., B. I. Budd, Pres., 72 West Adams St., Chicago, awarded contract for the construction of a 2 story, 60 x 150 ft. garage on 10th St., here. Estimated cost $150,000.

La., Algiers (New Orleans P. O.)—Todd Dry Dock & Construction Co., 25 Broadway, New York, N. Y., plans the construction of a ship repair plant, 10,000 to 14,000 ton capacity here. Estimated cost $750,000.

Mass., Newton (Boston P. O.) — T. H. Davis, 65 Union St., Newton, plans the construction of a 1 and 2 story, 55 x 80 ft. auto repair shop at 25 Paul St., Newton Centre. Estimated cost $50,000. Kendall, Taylor & Co., 142 Berkley St., Boston, Archts.

Mass., South Boston (Boston P. O.) — Gillette Safety Razor Co., 41 West First St., is receiving bids for the construction of an 8 story, 73 x 167 ft. blade building. C. T. Main, 200 Devonshire St., Boston, Engr.; also 8 story, 75 x 152 ft. handle building. Monks & Johnson, 99 Chauncy St., Boston, Archts.

Mass., West Springfield — New England Smelting Co., 220 Union St., is receiving bids for the construction of a 1 story plant. Estimated cost $40,000. I. W. Donahue, 105 Bridge St., Springfield Arcnt.

Mass., Worcester—Crompton & Knowles, 93 Grand St., has had plans prepared for the construction of a 4 story, 40 x 75 ft. textile machinery factory. Estimated cost $50,000. L. W. Briggs Co., 314 Main St., Archt.

Mich., Monroe—Detroit Stoker Co., 3118 General Motors Bldg., awarded contract for the construction of a group of buildings including a 1 story, 150 x 162 ft. pattern and storage shop on East First St.

Mo., Owensville — All Locking Zinc Shingle Mfg. Co., J. T. Tate, Secy., plans the construction of a 1 story, 50 x 155 ft. plant. Estimated cost $50,000.

Mo., St. Louis—Killark Electric Mfg. Co., 3940 Easton Ave., awarded contract for the construction of a 1 story, 140 x 180 ft. plant for the manufacture of electric equipment. Estimated cost $60,000. Noted Oct. 8.

Mo., St. Louis—Lloyd Insurance & Investment Co., Chemical Bldg., awarded contract for the construction of a 4 story, 77 x 109 ft. laundry machinery plant at 5147 Natural Bridge Ave. Estimated cost $75,000.

N. J., Newark—F. N. DuBois Co. awarded contract for the design and construction of a group of buildings for the manufacture of plumbing fixtures, faucets, lead traps, pipe, roof boxes, etc., to The Austin Co., 120 Broadway, New York.

O., Cincinnati — Cincinnati Ball Crank Co., C. Greene, Pres., awarded contract for the construction of a 1 story, 70 x 90 ft. machine shop.

Okla., Ponca City—Marland Refining Co. awarded contract for the construction of a 1 story, 90 x 200 ft. machine shop and a 1 story, 50 x 60 ft. blacksmith shop. Estimated cost $100,000.

Pa., Blairsville — Connemaugh Iron Works awarded contract for the construction of a 1 story, 130 x 312 ft. foundry, here, to B. H. Prack, Martin Bldg., Pittsburgh, Engr. Estimated cost $300,000. Noted Oct. 29.

Pa., Chester—Ford Motor Co., B. R. Brown, Const. Engr. Dept., Highland Park, Mich., will soon award contract for the construction of a group of buildings including a 1 story, 74 x 163 ft. car delivery shop, 455 x 812 ft. assembling building, power house, etc., at Front St. and Delaware River. Estimated cost $1,000,000. A. Kahn, Inc., 1000 Marquette Bldg., Detroit, Mich., Archt. Noted Mar. 19.

Pa., Philadelphia—General Electric Co., Witherspoon Bldg., will receive bids until Nov. 17 for the construction of a 1 story, 28 x 252 ft. galvanizing building at 68th and Glenmore Sts. Harris & Richards, Drexel Bldg., Archts.

Pa., Philadelphia — Philadelphia Engineering & Machine Co., 1130 Race St., awarded contract for the construction of a 1 story, 50 x 198 ft. shop and boiler house at 3456-3458 Ludlow St.

Wis., Milwaukee—Wellauer Estate, 3324 Sycamore St., is receiving bids for the construction of a 4 story manufacturing building on Huron St. Estimated cost $40,000. Reichardt Automotive Equipment Co., 91 Huron St., lessee. Noted Sept. 3.

Wis., Racine—F. J. Greene Engineering Works, 1020 Douglas Ave., awarded contract for the construction of a 2 story, 50 x 70 ft. addition to steel fabricating shop. Estimated cost $25,000.